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THE HAMILTON AND COEN GOLD FIELDS

(REPORT ON, BY LIONEL C. BALL, B.E., ASSISTANT GOVERNMENT GEOLOGIST).

[*With 2 Maps.*]

Presented to both Houses of Parliament by Command.

THE HONOURABLE THE MINISTER FOR MINES, BRISBANE.

Geological Survey Office,
Brisbane, 12th June, 1901.

SIR,—I have the honour to hand you Report on the Hamilton and Coen Gold Fields, with two maps, by Mr. Lionel C. Ball.

I have, &c.,
WILLIAM H. RANDS,
Government Geologist.

THE HAMILTON GOLD FIELD.

1. INTRODUCTION.

The Hamilton Gold Field forms part of the country of Balurga, in the district of Cook. It has an approximate area of 900 square miles. The present workings lie in the north-eastern portion of the field, on the watershed between the Lukin River and Kendall Creek.

A prospector named Dickie discovered gold in January of last year (1899), about 21 miles, in a straight line, south of the little town of Coen. At this spot the first Ebagoolah Camp was formed by the miners who rushed the field a couple of months later. There is now a surveyed town a mile to the north, with a population of 300 or 400.

The Hamilton can be reached from Cooktown either by land or sea. My instructions were to proceed to Laura and there meet Mr. Lee-Bryce, the Warden. In company with him I left Laura on 30th September. We crossed the Laura, Little Laura, Han (Station Creek), Morehead, Saltwater and Annie Rivers, reaching Ebagoolah on the sixth evening after leaving Laura; the total distance we found to be about 140 miles.

Between the Little Laura and Station Creek a red conglomerate (presumed to be of Upper Cretaceous Age) is sometimes seen, and a mile or so south of the Kennedy is a belt of dark-blue impure limestone. Septarian nodules occur in the limestone, but there was not time to search for fossils. Sedimentary rock gives way to granite at a point 10 miles north of the Morehead.

At Musgrave Telegraph Station is a small hot spring (temperature 100·5 degrees Fahr.), from which considerable quantities of sulphuretted hydrogen are evolved. Calcareous sinter is found covering an area 300 or 400 yards by 50 in the vicinity of the spring, but none is being deposited at the present time.

Sand and shingle cement deposits, due to the reconsolidation of weathered granite, are a peculiarity of the country south of the Annie River.

At the foot of the Mellwraith the granite is replaced by a quartz-mica rock, probably of sedimentary origin. This on the Mellwraith Tableland quickly changes into gneisses and schists, which extend to Ryan's Creek. Thence to Ebagoolah, and for 10 miles to the north of it, schistose and granite rocks are found.

The plateau on which Ebagoolah stands does not appear to have a greater altitude than 800 feet. The only conspicuous hills within many miles of the camp are Old and New Mounts Ryan and Mount Lee-Bryce. New Mount Ryan, which lies south of the camp, rises to 1,100 or 1,200 feet above sea-level.

Six miles east of Ebagoolah massive granite appears and forms the escarpment of the plateau there. From the foot of the range a low granite plain stretches away to the sea some 20 miles distant.

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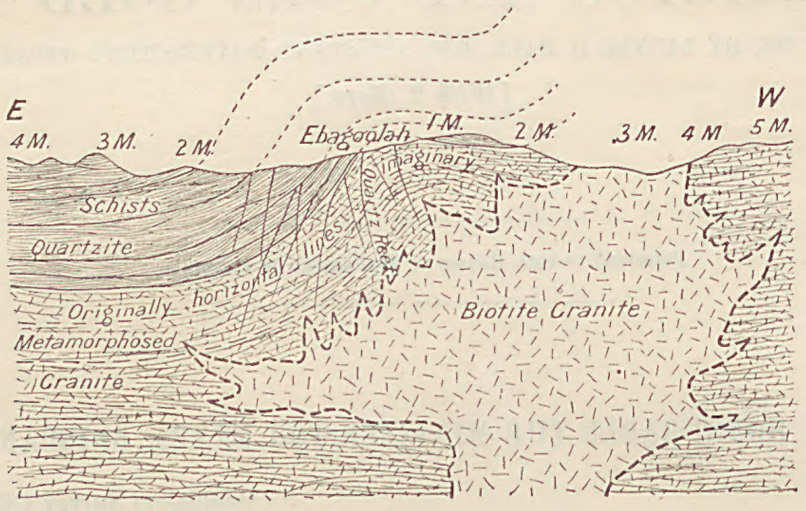
2. GEOLOGY.

The prevailing rocks on the Hamilton Field are schists and granites, probably merging into one another even when undecomposed, but in the weathered and altered condition in which they occur on the surface no exact line of demarcation can anywhere be laid down.

The gold-bearing zone, however, follows the general junction of the two rocks, the country on both sides carrying auriferous reefs.

It is most probable that the schists represent ancient sedimentary rock, and they rest on a still more ancient granite floor. When tilting (due to, or accompanied by, the intrusion of the biotite granites now outcropping on the west) took place, the junction of the sedimentary and igneous rock, being vertical, became a line of weakness along which gold-bearing solutions could find their way. [*See Sketch* 1.]

Sketch 1.



Diagrammatic Section through Ebagoolah.

Each of the distinctive rock formations is described separately below.

(i.) The Schists may be classified according to the predominant constituents—viz., mica, quartz, garnet, and sillimanite.

Muscovite (or sericite) schist occurs chiefly but not only on the eastern portion of the field; sometimes it forms the country rock of auriferous veins, as at the Golden Treasure. The laminations of the schists are not very distinct, except at one place a few miles north of the camp, where the contorted strata dip steeply to the south.

Quartz schists are found near Mount Lee-Bryce, in places having the structure of augen-gneiss, with "eyes" of quartz.

Garnet schist occurs much contorted on a ridge a couple of miles east of the camp, and in one place, in addition to garnets, sillimanite has been developed. Near the Four-mile Camp, on Ryan's Creek, small garnets are scattered through bands of glassy quartz in schist.

At the bottom of Dunwich Gully, less than half-a-mile from the camp, is an outcrop of sillimanite schist, the rock being composed of sillimanite (translucent fibres), quartz granules, and mica flakes. [*See Appendix A* (1).]

The schists on the east and north-east of Ebagoolah dip steeply to the east, but an area to the west seems to be flat-bedded.

(ii.) Gneiss, perhaps a much altered schist, is exposed in the bed of Ryan's Creek, below the Four-mile, between ordinary schists and biotite granite. Other outcrops are seen on the Laura track south of the same camp.

(iii.) Muscovite Granite, always in an advanced stage of weathering, occurs in contact with the gneissic schists, and very often forms one wall, at least, of the quartz veins. It is often seen near the reefs as pegmatitic dykes.

(iv.) Biotite Granite has been exposed in Ryan's Creek, at Grant's Camp, a short distance below the Four-mile. Another outcrop, between schists on the east and rotten granite on the west, lies about three miles to the west and north-west of Ebagoolah. Again it occurs in quantity three miles south-west of the Ten-mile Camp on the Lukin. [*See Appendix A* (2).] These outcrops of intrusive granite are most likely all connected.

In weathering, the biotite granite causes quite a different land contour to the muscovite rock, unweathered kernels of the former being scattered over the hills, which are rounded and free from sand ridges.

There is nothing to show whether the intrusion of the biotite granites was the result of the elevation and tilting of the schist and older granite (owing to secular cooling of the crust), or whether the intrusion caused the tilting. The newer granite, however, was in all probability connected with the formation of the ore veins. The biotite granite itself is as a rule free from quartz veins.

(v.) Eurite.—The porphyry dykes are characteristic of the biotite granite areas. West of the camp some 3½ miles, the dykes strike north and south or north-west and south-east. One of these is five feet wide and well defined. Other more lenticular outcrops occur in the same neighbourhood.

At the Star of Hope, south-west of the Ten-mile, is a belt of porphyry, about 20 yards wide, near the northern end, but tapering to the south. The rock is thin-bedded and much contorted in places, so that it has a great resemblance to a phyllite. Limonite pseudo-morphs after pyrites are developed on the bedding planes. A microscope section proves it to be eurite [*see Appendix A* (4)], the bedding being due to earth movements. The structure of the rock varies in different portions of the outcrop. One specimen obtained shows abundant phenocrysts of quartz, and is therefore quartz porphyry [*see Appendix A* (5)], while another shows scarcely any free quartz, and its base is more perfectly crystalline. [*See Appendix A* (6).]

Similar bedded rock to that at the Star of Hope forms the back of the ridge running south from the old camp. This has been partly shattered, and fragments are to be seen included in a quartz vein running through it. [*See Appendix A* (7).]

Other outcrops of this felsite, all thin-bedded and generally contorted, are found in the All Nations P.C., the Brilliant P.C., and at the Oom Paul, where it is slickensided, and gives a section almost exactly the same as that last described.

(vi.) Altered Rock.—A fine-bedded, much puckered, felspathic rock occurs about 2½ miles north-west of Ebagoolah. In the field it has every appearance of a sedimentary rock, being much finer laminated than the felsites. [*See Appendix A* (8).]

(vii.) Diorite occurs on a spur two miles due south of the Four-mile Camp, and is also found, as rolled blocks, in the bed of a creek about a mile from that camp in the same direction. The rock at the former place is *in situ*, but its extent was not traced. A specimen from one of the blocks proves, when sectioned, to be hypersthene diorite. [*See Appendix A* (9).]

Quartz diorite has been cut in the Trafalgar No. 2 S., in sinking and driving for the P.C. Reef. [*See Appendix A* (10).]

(viii.) Quartz Blows and Reefs not worked.—Just before entering the Four-mile Camp on coming from Laura, a great amount of quartz, running as lenticular veins in the schist, is seen. This has probably been leached from the surrounding rock, and deposited metasomatically on lines of weakness These quartz reefs are the special feature of the schists throughout their area.

A very pronounced characteristic of the field is the number of quartz "blows," usually forming ridges and small hills, whose sides are covered with their fragments. Locally known as "buck" reefs, they are thought to be barren of all metallic minerals, though such is not always the case. They vary from a few inches up to 15 feet in thickness, and their typical form is lenticular, the blow suddenly contracting just before cutting out.

The more prominent of such outcrops are seen on both Old and New Mounts Ryan, on the track between the Four-mile and Ebagoolah, on the ridges east of the latter camp, and in the neighbourhood of the old camp. The band of quartzite which runs right across New Mount Ryan may certainly be considered an altered sedimentary rock, the granular nature of the quartz, and the uniform width and great length of outcrop, all pointing strongly to this.

The parallel quartz reefs east of Ebagoolah, striking about north and south, and forming the back of a ridge, may also be much altered bedded deposits. Enough data were not collected, however, to be sure of that. As with depth a bed must either gradually become horizontal, or, if the dip remain constant, be faulted and thrust towards the surface, the gradually lessening dip of the May Queen Reef is in support of the assumption that these are altered sedimentary strata. [*See Sketch* (1).]

Less than a mile to the east of the town, striking in a northerly direction, are half-a-dozen beds of quartzite, differing in their mineral contents. The most westerly one contains a little muscovite only; the next much golden mica; the third is greatly stained in places with iron oxide; the fourth carries disseminated spangles of graphite oriented to a considerable extent, so that the stone has a schistose appearance; and the next bed carries both graphite and muscovite. These spangles of graphite are rounded, glossy, and black, and soil the finger on touching.

The series crops out along the top of a ridge for at least 1,000 yards. The quartz is sometimes schistose and sometimes sugary, which, together with its bedded occurrence and the disseminated graphite, prove it to be a metamorphosed sedimentary rock. These beds may be taken with the reefs east of the May Queen Line, and so would help to prove the sedimentary origin of all the schists east of Ebagoolah.

The blow of the quartz on the western side of which the first camp lay has been exposed in the alluvial workings in the bed of Dickie's P.C. Gully. On the surface to the north-west is seen a large mass of hungry quartz, extending for a few hundred yards, passing about 50 yards east of the Golden Treasure P.C. Shaft. In the workings referred to, the "blow" is seen to consist of a vein of quartz on the west, one foot in thickness, then two feet or three feet of rotten rock (possibly schist), another vein of quartz 18 inches thick, followed by six feet of quartzose granite, and, lastly, a two-feet quartz vein. The quartz is fairly compact, with a good deal of blue staining, and also some pyrites, and the most eastern vein contains some iron oxide, coating cavities. The underlie is a few degrees from vertical towards the north-east, and the general strike of the whole is due north-west. Payable stone does not seem to have been obtained from the few potholes sunk on the reef.

Of a peculiar nature is the large white "blow" crossing, in a direction 15 degrees west of south, the Ebagoolah Four-mile Track, about half-way between the two places. It consists of a central vein, in places 10 feet thick at least, of creamy, crystalline quartz, compact crystal aggregates having disposed themselves in radiating forms. A little mineral (pyrites, &c.) can be seen, but, as a rule, the quartz is white and pure, not even iron-stained. The radial structure gives place to a comby structure on the sides of the blow in what are most likely lateral veins. A little mineral is also developed there. The blow has been opened up at the True Blue, where it is essentially the same in form, but much more compact.

Midway between the track and the True Blue, the reef has cut out and a gully crosses it. The evidence points to this being a true fissure vein.

This line of reef is cut at a sharp angle about a quarter of a mile from the True Blue Shaft by another whose course is north-west and south-east, and which consists of a much more glassy hungry-looking compact quartz, showing little or no comby stuucture, but in one place a little plumbago-like gloss.

(ix.) Minerals are not in any variety on the Hamilton Field, as is to be expected from the prevailing rocks being schists and granites. The rocks consist essentially of quartz, felspar, and mica in a greater or less state of decomposition.

Sillimanite occurs in the schists east of the town, and mica is found both unaltered and as altered or secondary forms (sericite). A greenish decomposition product of muscovite is found in pegmatite such as that at the True Blue.

Garnets are disseminated in the schists on the ridge extending north and south about a mile and a-half east of Ebagoolah, and in bands of quartzite in the schists near the Four-mile Camp.

Flakes of graphite occur in quantity in many of the quartzites, and, like the sillimanite and garnet, indicate a sedimentary origin. Grains of ilmenite are obtained on washing the alluvial in Dunwich Gully.

Throughout the field the quartz has a peculiar bluish colour, possibly due to finely disseminated pyrites; for undoubted pyrites impregnate many of the reefs, and that, too, quite near the surface, the best example being the Johannesburg, where galena is also found in small amount; galena seems to be present also in the central reef at the Gold Mount P.C.

The Gold.—The Hamilton Gold is distinctly poor in quality, the ratio of gold to silver, according to the assays quoted under the descriptions of the mines, varying from 3 : 1 to 1 : 6. The price given on the field for alluvial gold is £2 16s., but the Warden gives the value of reef gold as £2 19s. per oz.

A large amount of the alluvial gold is contained in limonite pebbles, but a good deal also impregnates quartz fragments. It occurs chiefly as somewhat flattened particles, a little larger than a pin's head. Nuggets are of extremely rare occurrence now, and when one is found, even if only one ounce in weight, it causes much excitement. The largest nuggets were found on the surface in Corbett's Gully, but the heaviest contained at the most only 100 oz. of gold.

3. THE REEFS.

As will be seen from the map, the zone of country including the reefs now being worked has a north-westerly trend, though the general strike of the reefs themselves is much nearer north and south. It will also be noticed that this zone is on the junction of the schists and granites, both of which are, in all probability, of metamorphic origin.

Quartz deposits on the field are either leaders, independent veins, or compound reefs.

The first are of any thickness up to six inches, and would appear to have been deposited in small shrinkage cracks in the granite, for, though often very rich, they seldom extend to any depth, nor yet have they any permanence along their length. The gold has been deposited in the leaders, more especially in bunches, as at the Kruger, Tasmania, and Agnes (which last, however, may prove more than a leader). The Broad-arrow Leader, on the contrary, was uniformly impregnated. Most of the alluvial gold seems to have been derived from the disintegration of such leaders, there being no other way to account for it. As a rule the leaders are found when working the alluvial.

Ordinary independent and true fissure reefs are represented by the Caledonia, All Nations, Trafalgar, and Star of Hope Lines. They are due to the crushing of the country on the junction of the sedimentary and older granitic rocks.

Reefs of the third kind may be either compound fissure or compound bedded and fissure veins. Compound fissure veins such as the Gold Mount and True Blue seem to have been formed by a reopening of the fissure between the reef and the walls. Thus these reefs have required three periods for their formation; the first for the formation of the large central vein hitherto thought on the field to be barren, but lately proved at the Gold Mount to be pyritous at a depth of about 100 feet, and then successive periods for the veins on the sides. The central deposit might, however, in certain cases be a segregation vein. Usually one of the lateral and smaller veins is comparatively poor in gold, while the other is rich.

Compound reefs would be possible under the conditions advocated above—viz., the formation of fissures along an almost vertical bed of quartzite, tilted by the intrusion of granite. Percolating solutions, heated and rendered more active, both chemically and physically, by the intruding granite, would be quick to take advantage of such passages. The gradual lessening with depth of the dip of many of the reefs points towards their being bedded deposits, but the slickensided surfaces of compound reefs prove that they are on lines of fissure. In this case true fissure veins may have been formed beside beds of quartzite and felsite, which would at the same time be altered and, perhaps, enriched. Reefs of the last kind appear at the surface as blows, as, for example, the May Queen and that on the ridge just west of the old township, where fragments of the felsite walls are to be seen actually in the quartz vein, proving its origin by chemical precipitation in a fracture.

The bleached appearance of the outcrops of these reefs may be due to prolonged atmospheric action not only having decomposed the sulphides, but also having removed the usual red iron staining.

The parallelism of the Ebagoolah Reefs and the liability shown by them to suddenly cut out are their most noticeable features. Owing to the water-level being at only a slight depth—water was struck, even in the late dry season, within 70 feet—sulphides are found almost at the surface. The plumbago flucan or selvage, often having the appearance of a black shale, seems to be a very good indication on the Hamilton of gold in quantity, and is found as a rule only on one wall.

The output of gold for 1900 is given as 806 oz.; that for January, 1901, as 1,006 oz. from 209 tons; and for February, 430 oz. from 150 tons crushed. Though the value of the battery gold is returned by the Warden as £2 19s. per oz., the gold from the separate reefs varies greatly in fineness, so that the mean value will vary from year to year.

As crushing costs £1 10s. per ton, and carting costs from 10s. to £1 10s., it will be seen that quite an ounce may be necessary for these items alone, and then the cost of mining has to be taken into consideration, so the miners generally will not touch a reef yielding less than 1½ oz.

Following are the reefs in alphabetical order:—

Agnes Line of Reef.—The second last discovery—the Agnes—is in Corbett's Gully (a slight depression on the east of the ridge formed by a quartz blow running north and south 20 yards or so west of the old town). Several hundred ounces of gold have been found in this gully, many nuggets being found below the position of the present shaft. One of these nuggets, including a little dogtooth quartz, weighed 90 oz. Though so much work was done here, no one succeeded in unearthing any of the reefs or leaders shedding the gold till the Agnes was discovered by trenching. It is just possible that this is a continuation of the Golden Treasure line.

Agnes P.C.—The spot where the shaft has been begun is a couple of hundred yards south of the old post office. In the trenches were leaders underlying to the east, but a few feet below a vein of quartz, 12 inches wide, was brought to light. The quartz carries little dogtooth, and is stained blue to some extent, but it is not possible to say more yet than that the stone is auriferous. In the shaft the strike is five degrees east of north, but the leaders in the trenches show that this is only temporary and may vary greatly.

All Nations Line.—Lying a quarter of a mile north of the old camp this reef on the surface was a leader, poor in gold, but increased in width and richness as it was sunk on. The "numbers" (the adjoining claims), as usual, have had some little trouble, especially on the north, where the reef has now been found somewhat out of the course of the P.C. and No. 1 S.

All Nations P.C.—For about 20 feet from the surface the reef was found to be much broken up, good gold occurring only where well defined. Below a depth of 20 feet it dips 65 degrees to the east. The lode material is a sharp white quartz with blue patches. A breccia of quartz, with a plentiful iron cement, occurs on the hanging-wall, and varies from a few inches up to 18 in thickness, and carries good gold; a fair amount of it is to be seen in the ore paddock.

At the beginning of the underlie the reef is four feet six inches wide, and of this from six inches to two feet is auriferous. At 35 feet depth the thickness is six feet, four feet of it being very rich but not all solid quartz. On the bottom of the shaft, which is 70 feet deep, the reef is widening after a slight contraction to five feet. The country rock is a golden muscovite schist, much stained with red oxide of iron near the shaft bottom. The footwall is the finest possible, with perfectly developed slickensides.

The discoverers of the reef were not experienced miners and sank the shaft on the footwall, without always taking care to locate the hanging-wall. On reaching the water level, at a depth of 70 feet, a drive was put into the north for 10 feet, showing that the reef gradually turns round to the north-west and at the same time is cutting out. In a drive on the south side the lode runs 10 degrees east of south, and has cut out within 20 feet, the lode material being replaced by schist, though the walls are still well defined. A small stope has been begun on the south end of the shaft, 20 feet above the bottom, where the reef is four feet thick, but tapering towards the surface.

Shoots of gold fall towards the north, one at the top of the underlie and another at the bottom of the shaft, where the free gold can be seen in the stone. Near the surface the reef does not contain more than one half ounce per ton, but the stone at grass (derived from the shaft, the drives, and the small stope) shows free gold throughout.

In January of this year part of this stone (the "firsts"), amounting to 12½ tons, was crushed locally for a yield of 600 oz., and in February 32 tons of "seconds" yielded 64 oz. A sample taken by me from the bottom of the shaft, the length of the drives, and the sides of the shaft, yielded on assay—

Gold	...	...	...	...	2 oz. 2 dwt. 11 gr. per ton.
Silver	...	...	...	...	1 „ 14 „ 15 „ „

the coarseness of the gold in places probably accounting for the discrepancy.

The present manager is closing the drives because of temporary lack of timber, and intends to use that available in timbering the shaft, which is to be deepened; but water has been struck, and before sinking further it will be necessary to instal a pump. As seen in the P.C. Shaft, this reef is undeniably a fine one, and there can scarcely be any doubt that it is a true fissure vein—the slickensides and breccia proving that movements of the walls have taken place.

All Nations No. 1 S.—On this claim, a few hundred feet from the P.C. Shaft, is a six-inch leader dipping to the east. It may possibly be the P.C. vein, being, like the latter, poor in free gold at the outcrop. For this reason, a shaft is being sunk to the water level in the country on the west or footwall, and on reaching it a crosscut will be put into the reef, when, if still poor, it will be abandoned. The country rock here is a micaceous schist or gneiss. An auriferous "floater" or shoad has been found on the surface to the west of the shaft, so it is intended to drive in that direction also.

Beyond the boundary of the No. 1 S. Claim, prospecting is being carried on for the reef.

All Nations No. 1 N.—The first shaft on this property was sunk to a depth of 40 feet on the apparent strike of the reef (as seen in the P.C. Shaft), and then a crosscut was carried 40 feet to the west, but without cutting the vein. Then by trenching a couple of leaders were opened up, quite out of the line of the P. C. Reef, and on them a shaft has been sunk to 14 feet depth. A few feet west of the shaft a strong leader was found by the fourth party who took up the claim, and they sank 20 feet on it. This leader or reef varies from four to 12 inches in width, strikes 40 degrees west of north, and dips 60 degrees to the east. The lode material is very similar to that of the P.C., and has given fair prospects of gold so far.

Although the shaft was so shallow, a sample was taken from the top to bottom of both sides, the assay of which is given below—

Gold	1 oz. 7 dwt. 10 gr. per ton.
Silver	11 „ 2 „ „ „

A decomposed coarse granite forms the hanging-wall, which, like the foot, is well defined; the foot-wall is strongly slickensided and has adjacent to it a blue graphitic flucan—on this field a very good indication of the presence of gold. It is very probable that this and the P. C. Reef will prove to be one and the same, as the latter is bending round towards the north-west, while this reef apparently runs about north-west and south-east.

A few yards north of the shaft is an outcrop of contorted bedded felsite having a general strike of five degrees west of north, which on reaching the reef either cuts through it or is cut through, for it forms the footwall in the underlie shaft, and the reef can be seen undeviated in a trench west of the felsites. Owing to the small amount of work yet done, the true relation between the reef and the dyke cannot be seen. Pseudomorphs after pyrites are to be found in the felsite, and the whole occurrence is very similar to that at the Star of Hope, where a dyke of porphyry meets the reef and runs along with it for a time. The perfect bedding of the rock—due to earth movements—gives it every appearance of a sedimentary rock.

All Nations No. 2. N.—A well-mineralised (*i.e.*, pyrites bearing) quartz vein, 18 inches thick near its outcrop, is worked here and yields a little free gold; the strike is 30 degrees west of north, so that very probably this is the same reef as that being worked in the No. 1 N. The vein is vertical, and at a depth of 25 feet is cutting out while another is making.

Brilliant Line.—This, lying three-quarters of a mile east of the old township, is practically in the course of the May Queen line, with which it may possibly prove to be connected.

Brilliant P.C.—Trenches only have been so far opened on this claim, which is within a few hundred yards of the May Queen P.C. The auriferous vein, striking 30 degrees west of north, lies on the west of a small blow of quartzite which is definitely laminated. The vein varies from two to three feet in thickness, but in the trenches it is difficult to distinguish the vein stone from the compact quartzite on the eastern wall. A parcel of 11 tons, put through the newly-erected battery in November, yielded only 9 oz. 8 dwt. of gold.

Brilliant No. 1 S.—Here some trenches have been dug but the claim has been abandoned.

Broadarrow Line.—A typical leader, cutting out in a short distance in all directions.

Broadarrow P.C.—A shaft was sunk on the leader, which ran in a north-easterly direction across the old police camp, dipping steeply to the south-east. At 10 feet depth the leader cut out and was abandoned, though it yielded good returns while it lasted. At the shaft bottom the soil is just giving place to a decomposed granite.

Caledonia Line.—The Caledonia line is one of the favourites of the field, though the "numbers" have had the usual difficulty in finding the reef. The claims lie on a north and south line on the west side of the surveyed town, but in the centre of the present camp of tents. The reefs worked on the numbers are not on the course of the P.C. Vein, and they may be in separate fissures, in which case there must be a number parallel and of no great length, in a small width of country. Such an occurrence would not be impossible in rock crushed like this. The Caledonia Claims are on a very gentle slope to the west, which promises to be a swamp in the wet season.

Caledonia P.C.—The whole country here being covered with rotten granite and under water at parts of the year, the reef does not outcrop, but was discovered in sinking the hole for a tent-pole. A shaft now 60 feet deep and untimbered, except at the brace, has been sunk on the underlie, but no drives have been opened.

In the shaft the reef runs five degrees east of north; it is vertical for 30 feet, and then dips about 10 degrees to the west. At 40 feet depth, the reef is five feet in thickness, but in places there are only three feet of white compact quartz on the hanging-wall, with three feet of interlaminated quartz and country on the footwall. A ferruginous vein on the hanging-wall varies from six to nine inches in thickness, shows free gold, and appears to be increasing in size and richness. The auriferous vein material as seen in the ore paddock is a white and brown compact quartz, with soft bluish patches, probably due to graphite. Only 12 or 18 inches of the whole reef is saved, picked partly from the foot and partly from the hanging wall.

During January of this year, 38¼ tons crushed for 269 oz. 13 dwt., but a sample taken by me from the whole reef at the bottom of the shaft yielded only—

Gold...	3 dwt. 22 gr. per ton.
Silver	8 „ 12 gr. „ „

which low result might be explained by the coarseness of the gold.

The country in the hanging-wall is a much decomposed felspathic rock, while that in the footwall is a plumbago-lined and stained quartzite showing slickensides. The absence of continuous and well-defined walls (down to 40 feet at least) somewhat negatives the fine appearance of the reef, but this is well above the water-level, so it is rather early to speculate on the nature of the vein.

A leader has been exposed a short distance east of the shaft, but no work has been done upon it. A pit a short distance south of the main shaft has been opened on a quartz outcrop, three to four feet wide, on the course of the main reef.

On the southern boundary of the claim, about 150 feet from the shaft, is a trench from four to six feet deep on a line between the P.C. and the No. 1 and 2 S. shafts, and some four or five leaders were found there, so there is a chance of the reef on the two claims being continuous at a depth.

Caledonia No. 1 and 2 S.—The reef exploited here was found by sinking a shaft 20 feet and then crosscutting to the east, when in a few yards a leader was struck. This quickly increased to 18 inches, and varied from 20 to 22 inches in thickness nearly to the water-level, where it is 3 feet thick and shows pale free gold in places. It is vertical for 25 feet from the surface, then underlies 75 degrees to the east for 25 feet, and then 85 degrees to the water-level at 70 feet depth. The general strike of

the vein is five degrees west of north. Drives have been carried to the north and to the south along the reef at the 60-feet level, both for about 15 feet. At the north face of the level the reef is 18 inches wide, the nine inches of stone on the hanging-wall being much stained and richest in free gold of the usual pale colour. The ore is firm white and yellowish quartz with blue stains.

A sample from along the north and south drives assayed—

Gold	1 dwt. 23 gr. per ton
Silver	5 „ 21 „ „

The battery returns for the last quarter of 1900 give the yield as 34 oz. for 30¾ tons crushed, which is the least to be expected from most of the ore seen at grass.

The uniform body of stone in the south drive has good walls, the hanging-wall being beautifully slickensided, but the footwall is not very distinct. The country is a decomposed muscovite rock, the mica of the footwall country being darker than that of the hanging-wall, except for a small band of white mica which is taken as the actual footwall. In the drive to the south the hanging-wall, though quite plain, is not slickensided. Towards the surface, where at 12 feet depth the reef pinches out, the walls are still well defined.

The position of the shaft on this claim is some 50 feet east of the line of strike of the P.C. Main Reef, so either that reef has made a slight bend (or been faulted), or this is the reef found on the Prospecting Claim east of the main shaft. The former is quite probable, though it is worth remarking that the No. 1 and 2 S. is in mica rock, while the country of the P.C. vein is felspathic. In addition, the slightly different dips and strikes on the two claims would point to their being on separate reefs.

Caledonia No. 3 S.—Here the country is apparently a muscovite schist, while to the south-west is a muscovite granite. A shaft was sunk 40 feet, and crosscuts put in to the east and west without meeting the reef, but passing through hard "bars" of granite.

Caledonia No. 4 S.—A leader of white dogtooth quartz was followed down for 18 or 20 feet and then abandoned. A shaft is being put down on the boundary with No. 5 S., where good prospects were obtained by washing the soil.

Caledonia No. 5 S.—This appears to be on the border of schists and granite—both in a decomposed state. The shaft at 50 feet depth passed from schists through six feet of soft plumbago-like flucan on to a hard quartz rock dipping to the east. A three-inch leader comes below, and then the footwall country is seen to be a rotten granite like that in No. 1 and 2 S. The leader runs 30 degrees west of north, and probably is vertical below where struck, but gives signs of fraying out into leaderlets. At the bottom of the shaft (70 feet from the surface) both foot and country wall hanging-rocks are much broken and slickensided, the eastern wall bearing a fine polish wherever exposed. The schists and leaderlets it contains dip to the north-east, while the granitic schistose country appears to dip to the south-west. The reef is hungry-looking quartz and carries no gold, so after sinking 20 feet further the mine was abandoned.

The shaft lies some 50 yards east of the course of the P.C. vein, so is probably on a different leader, owing its existence to the crushed state of the country rocks.

Caledonia No. 1 N.—A shaft has been sunk to a depth of 46 feet in a white mica granite, a little east of the P.C. reef's course, and about 100 feet distant from the P.C. Shaft. At the bottom is a mass—perhaps a vein—of coarse granite, consisting of pink felspar, quartz, and mica altered to a green chloritic mineral. A couple of veins of more or less decomposed pegmatite were struck in the shaft and in a level at 27 feet depth.

A tunnel driven to the south-west came, at six or seven feet from the shaft, on a slickensided surface and a little quartz leader, then passed through a couple of feet of rotten granite, and then through a quartz vein into granite again. This vein varies from four inches in thickness near the bottom of the drive to 18 inches at the top, and it dips to the east. It may be the P.C. Reef, but the miners passed on into the granite—without, however, finding further trace of a reef. They therefore intend to sink on the vein. The quartz is white and vitreous, but somewhat stained in parts.

A sample taken from both walls of the tunnel to see if the vein there contains anything at all, results in—

Gold	1 dwt. 12 gr. per ton.
Silver	3 „ 22 „ „

Caledonia No. 2 N.—Abandoned after sinking 35 feet, and driving without finding a payable reef.

Caledonia No. 3 N.—Abandoned after trenching had resulted in showing up only a couple of quartz leaders running about north-east, one a foot wide, the other a few inches.

Caledonia No. 4 N.—A reef in this claim several hundred yards west of the course of the P.C. can be seen in a shaft to taper from a width of two feet at the surface almost to a plane 20 feet below. The shaft being continued 20 feet more, again struck the reef—a somewhat flinty quartz with patches stained blue, but carrying no free gold. The first 20 feet of the reef had been auriferous, though scarcely payable.

Some 30 yards west of this shaft is another on a leader running north and south, and dipping 60 degrees to the east, which cut out at a depth of 30 feet. The stone from the leader in this and the next claim to the north was sent to the battery in November as one parcel of 24 tons, and yielded 41 oz. 16 dwt. of gold. East of the first shaft are a couple of leaders in schistose country, which must have been greatly shattered to allow the formation of so many veins.

Caledonia No. 5 N.—The leader found on the west of the No. 4 N. Claim has been worked here by a shaft, and a vein to the east has been opened up by a trench. Little work has actually been done yet. A 1¾-oz. crushing by the local battery has been noted under the description of No. 4 N.

Croydon King Line.—This line of reef lies some four miles south of the town. It is not the only one in the locality; there is another a few hundred yards away in a northerly direction, striking north-east and dipping south-east, so that in all probability the reefs intersect.

Croydon King P.C.—The P.C., the only claim on the line, lies on the south-eastern side of a gully running to the south-west. The reef, which was abandoned because of poverty in free gold, strikes north and south with a dip to the west. The country is decomposed granite, and the vein, which is more than a foot in thickness, is a firm bluish quartz.

Democrat Line of Reef.—The strike of the Democrat is seen to be a few degrees west of north, and it has been exposed by trenches right across the south-eastern flank of Hospital Hill. In Dunwich Gully the reef outcrops in the bed of the creek, but is not auriferous on the surface there. This is one of the latest reefs on which work has been begun. One claim has been taken up on the south and one on the north of the P.C.

Democrat P.C.—A vertical leader from three to six inches in average thickness, though almost pinching out in places, has been sunk upon in a country of rotten granite, with veins and lumps of undecomposed muscovite granite. The leader has a strike 20 degrees west of north. (Near the shaft bottom another leader is coming in from the north-east.) Both walls are fairly good, and the eastern one shows traces of slicken sides It may then be put down as a true fissure vein because of its definite and partly slickensided walls, and its generally regular course. During the last quarter of the year four tons of the stone, crushed locally, yielded 26 oz. 10 dwt. gold.

Good Luck Line.—This, the last reef taken up, lies about a mile south of the old camp, and half-a-mile north of the Last Hit.

Good Luck P.C.—Payable gold was reported from this claim in November, and work had just begun at the time of my visit. The country rock is a muscovite granite, in which the reef seems to dip at an angle of 30 degrees to the south-east, while its course is north-east and south-west. A wide trench (less than five feet in depth) has been dug on the outcrop, disclosing a ferruginous white quartz not carrying mineral on the surface.

From the amount of ore at grass, the horizontal portion of the vein at the surface must have covered several square yards.

Golden Treasure Line.—The reef lies just on the east of the old township, and quite close to the alluvial P.C. of the field, but on the opposite side (*i.e.*, the western) of the ridge on which the camp was built. Besides the P.C. there is one number on the north and one on the south; that on the north has been so far unsuccessful in quest of the reef, and the exempted No. 1 S. has only a few leaders. Owing to the large reef on the east, which has formed the back of the ridge, the Golden Treasure vein does not make any show on the surface.

Golden Treasure P.C.—This, one of the first reefing claims applied for, shows comparatively little work done, the owners being apparently afraid to sink. The vein has been opened up by a shaft to a depth of a little over 60 feet, and it has been driven upon at 58 feet depth for 30 feet to the north, at 50 feet for a similar distance, and for 20 feet or so at 25 feet depth. These 50 and 58 feet levels have been connected by a winze for ventilation, as it is intended to stope up from the latter level.

The roof strikes north five degrees east—that is, at the 50-feet level, where the best opportunities were for taking the observation—and it underlies only four degrees from the vertical to the west to near the bottom of the shaft, where there is a slight bulge to the east. Towards the surface the reef is not well defined, being apparently somewhat split up into veinlets. In the 25-feet level, the thickness is 18 inches at 20 feet from the shaft, but 10 feet nearer the shaft it almost pinches out, makes a bend of a foot, and then runs on parallel to the portion before the bend. In the 50-feet level the vein is still 18 inches wide, increasing to two feet at the face, where, however, the veinstone includes some country rock.

The quartz is white and somewhat glassy, stained on the cracks with ferric oxide, and fairly well mineralised. Penetrating and embedded in it the gold occurs as strings and coarse grains. This very rich stone, however, occurs only as bunches, one of which was lately struck near the bottom of the shaft. The remainder of the stone may carry gold, but much free gold is not visible in it. A specimen from this reef, much talked of in the North, was said to weigh 9 lb. and to be half gold. The gold in it really would not be one-tenth of its weight, nevertheless it made a fine show. No sample was taken from this mine, the owners being afraid that the chips taken might be slugged with gold, and besides a sample could give no idea of the true contents of such a patchy reef. During the last quarter of 1900, however, 8¼ tons of the stone were crushed for a yield of 141 oz. 10 dwt., and 40 tons are reported to have been crushed in February of this year for 355 oz.

In the 25-feet level the country is a segregated quartz-mica rock, but elsewhere it is a rotten micaceous and felsitic schist. The walls in the 25-feet level are well defined, and the hanging-wall is slickensided. In the 50-feet level the footwall is plain, and there is a slickensided fault a couple of feet from the vein in the hanging-wall country, but at the end of the drive, where the reef carries included country, no proper wall can be distinguished. In the shaft at this level a "horse" of country is seen, but at the bottom the legs are approaching one another, being now only 18 inches apart. A one-inch leader dipping slightly to the west is visible a foot or so on the west of the main vein.

Golden Treasure No. 1 S.—This claim is under exemption just now, and so far only a couple of two-inch auriferous leaders some 20 feet east of the course of the P.C. have been discovered

Golden Treasure No. 1 N.—Here a shaft was sunk 60 feet west of the line of strike of the P.C. Vein, to a depth of 49 feet in seven weeks, by two men working one shift a day, who then drove to the east at the rate of seven feet a week, the rock being very rotten. Decomposed granite, apparently dipping to the east, was passed through in the shaft, and for 37 feet from it in the crosscut, when a fissure plane was met with, and a few feet further they came on a well-marked fault in which is a slicken-sided graphitic and chloritic material with leaderlets of quartz.

It is possible that this is a node of the reef—*i.e.*, a pinched-out portion—though the P.C. Vein should be still further to the east. The miners are now driving west.

Gold Mount Line.—The Gold Mount is locally considered to be one of the best reefs on the field, but its nature is problematical in the present stage of the workings. The outcrop has been traced for something like 1,000 feet, the reef seemingly pitching from the surface at the south end. Much of the quartz has a peculiar blue tint in blotches, such stone here being as a rule richer in free gold than other quartz. Alluvial workings exist in the gullies below, and it was by following these gullies up

that the outcrop was discovered. The reef strikes across the end of a spur running easterly from Old Mount Ryan, and is well situated for dumping mullock; in addition, a wholly down grade road is to be constructed, or rather cut, to the local battery, though it is expected that the reef would keep its own battery working, should one be erected.

Gold Mount P.C.—On this claim there are two shafts on different veins, that on the eastern vein being 95 feet deep, the other 30 feet. The former reef is from 15 inches to four feet in width, and averages two feet to the bottom, the latter shows five feet of quartz in one place, but the main portion of the reef carries much country. Between these two reefs trenches have proved that there is nine or 10 feet of quartz, and there is possibly more; but this, though it carries gold, has not yet been thoroughly prospected. The reefs strike north five degrees west; and, while the western or footwall reef, as it is called, is vertical for nine feet, and then dips 50 degrees to the east to the shaft bottom, the hanging-wall reef dips 70 degrees for the first 45 feet, and then 60 degrees in the same direction, so they are gradually converging.

The quartz of the hanging-wall vein is the richer of the two; it is stained to a greater extent, but carries less country than the other; in it a little "mustard" gold occurs in black graphitic patches, but most of the gold is fairly coarse (which explains the difference between the yields of the bulk crushing and the samples). The first sample was taken from both ends at the bottom of the shaft in the eastern vein, and assays—

Gold	4 dwt. 13 gr. per ton.
Silver	9 „ 20 „ „

A second sample from the bottom of the shaft on the western vein yields—

Gold	6 dwt. 11 gr. per ton.
Silver	9 „ 3 „ „

A third sample from the surface of the 60 tons of ore at grass assays—

Gold	4 oz. 6 dwt. 5 gr. per ton.
Silver	2 „ 9 „ 15 „ „

A crushing of 37 tons 6 cwt., however, was put through the battery a week before Christmas for 2 oz. 17 dwt. gold per ton.

Since my visit the main shaft has been sunk 10 feet—*i.e.*, to 95 feet from the brace—and a crosscut driven into the central vein, of which some specimens sent me are hard white, somewhat cellular quartz with blotches of graphitic flucan, a fair amount of golden pyrites, a little galena, &c. These assay—

Gold	2 dwt. 14 gr. per ton.
Silver	13 „ 17 „ „

The country rock is mica schist, the actual footwall of the reefs being a soft plumbago flucan, while the hanging-wall is a yellow clay selvage, polished in places almost like metal; a foot or so of crushed and quartz-veined plumbago-bearing country separates the hanging-wall vein from the central reef.

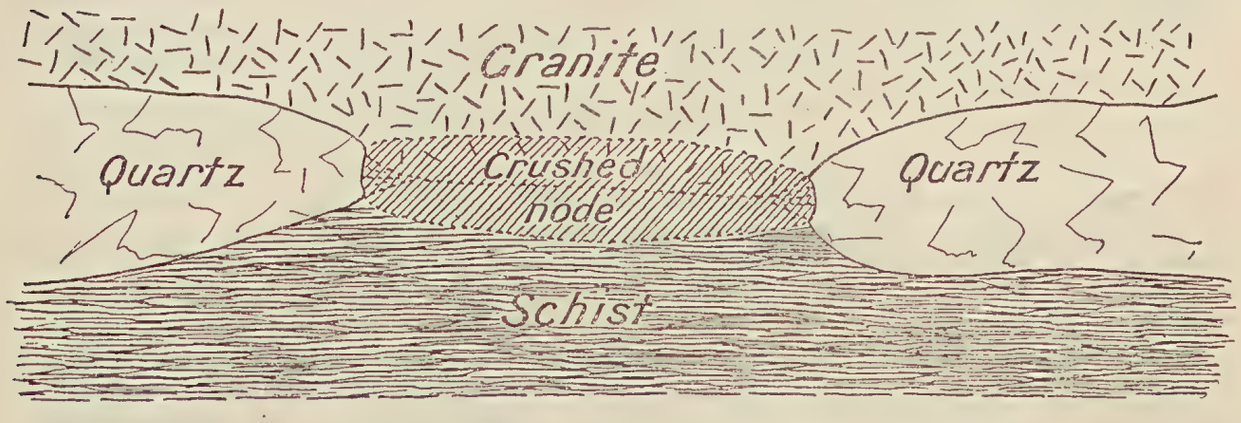
A couple of hundred feet east of the main line is a leader in decomposed micaceous rocks running to the north-west and dipping to the south-west.

Gold Mount No. 1 S.—Two reefs are visible here near the surface in one shaft, the dip of which is gradually decreasing with depth. They are in the line of strike of the P.C. Reef, and were both from 18 inches to two feet wide at the top of the shaft. The western one cut out, however, at a depth of 25 feet, but the other, which was two feet from it, is descending as a leader. A couple of feet further east a third reef has been struck, but not yet broken into. The footwall is very good. As yet the reefs are rather poor in gold.

In a trench a little north of the shaft, the two veins are seen again of the same thickness, and the same distance apart, but half a dozen yards south of the shaft is the side of a gully in which no outcrop appears, so that the vein must either cut out altogether or pitch in that direction.

Gold Mount No. 1 N.—The lode here is in a very unsettled state, consisting of a bluish materia with numerous quartz reeflets and slickensides developed throughout it. It is quite possible that the shaft, now 25 feet deep, is on a node of the fissure, as shown in Sketch 2.

Sketch 2.



A sample from all parts of the shaft gives—

Gold	23 gr. per ton.
Silver	4 dwt. 6 gr. per ton.

The country on the west is red schist; on the east is a coarse granite, possibly an altered sedimentary rock, but more likely a segregation mass. The footwall is good Below the shaft on the creek to the north, the reef outcrops some 100 yards away, but is seen to be still much broken up and iron-stained.

Gold Mount No. 2.—This claim is just across the creek from No. 1 N., and though six or eight feet of outcrop like that in the creek is visible, it has as yet only been trenched. It was found to be free of gold on the surface.

Hamilton King Line.—The Hamilton King Reef must run within 100 yards of the All Nations P.C. on the east, but has only been worked at a point about half-way between that claim and the old post office. The reef, now practically abandoned, was the first taken up.

Hamilton King P.C.—This, the reefing prospecting claim of the field, carried splendid gold at the surface. It lies a few hundred yards north of the old town. The reef dips to the east and strikes north and south in schistose country; and the veinstone is the hungriest possible looking quartz, with bunches and bands of beautifully radiating quartz crystals ("dogtooth"), between which the gold was found. One would seldom expect to find gold in such stone as this, even as a secondary deposit in cavities, and the supply is thought to have now given out or greatly diminished with depth. However, 14 tons of stone (the first parcel) were crushed in January (of this year) for 19 oz. of gold.

Hidden Treasure Line.—The reef lies about a mile a little south of east of the new town, and half-a-mile north-east of the old camp. It is distinct, and can be traced for half-a-mile in a south-easterly direction from the No. 1 N. Shaft. The nature of the ore, the uniform width, and the length of outcrop make a favourable impression.

Hidden Treasure P.C.—In this mine there are two reefs in contact, of which one is rich, the other poor (containing not more than 15 dwt. per ton), and each varying from 12 to 18 inches in thickness. Their course is north 130 degrees east at the surface, but at the bottom of the shaft it is north 138 degrees east, and there they are separated by a couple of feet of quartzose mica schist, the country rock being a simple mica schist. For eight feet from the surface the reefs are vertical, and then underlie 85 degrees to the north-east to a depth of 69 feet, where the inclination is becoming less. The quartz is very likely-looking stone, and shows the blue patches. Stone from the hanging-wall reef near the shaft bottom assays—

Gold...	...	...	...	...	2 dwt. 14 gr. per ton.
Silver	...	...	...	...	7 „ 4 „ „

but 12 tons crushed on the field in February yielded 22 oz. 12 dwt. of gold.

The footwall is very hard and definite, but a close inspection was not possible owing to its coat of mud and slush. The hanging-wall is not strong, but is marked by a "dig" of blue clay (slickensided in parts), adjacent to which is the richer of the two reefs. Water is flowing into the shaft at the bottom at a rate of 150 to 180 gallons per day, so attention has been given to timbering. The fact of water flowing from the reef is looked upon by the miners as a sign of permanence, the value of which is, however, rather discounted by the general water-level being so near the surface in the district

Hidden Treasure No. 1 S.—A few trenches have been opened on this claim, but it has now been abandoned.

Hidden Treasure No. 1 N.—Here the vein appears to run north 35 degrees west (observed on the underlying portion); it is vertical for 30 feet, and then underlies east about 30 degrees. The shaft is a large one, well timbered, and reaches a depth of 50 feet. On the hanging-wall is a leader of ferruginous quartz from four to six inches thick, then a foot of blue-stained quartz and 12 inches more of quartzose material. The quartz at grass looks very well, pyrites being present, and free gold—most likely from the leader—can been seen in a reddish quartz. There are 30 tons of picked stone in the paddock. The hanging-wall is a very good one, but the footwall could not be seen. The claim was under exemption at the time of inspection.

Hit or Miss Line.—The Hit or Miss Reef is the southern prolongation of the May Queen line, which is here not so strongly developed as the north end. Very little work is being done, in spite of the reported richness of the crushings obtained. It crosses the road from Ebagoolah to the Four-mile, at little more than a mile from the old camp.

Hit or Miss P.C.—Work cannot be said to be carried on energetically here. A shaft has been put down 60 feet, and timbered to 30 feet, just below which there was a stage or sollar covered with rubble, preventing further descent. Only a few square yards of the deposit were visible below the timbering, and there it appears to be a jumble of quartz veinlets and micaceous country without defined walls. The strike in the shaft is about six degrees west of north, and the dip is 80 degrees to the west.

The miners had picked the ore into "firsts," "seconds," and "thirds," of which the firsts, amounting to 46 tons, have since (in February) been crushed for a reported yield of 233 oz. The surface stone is said to have been extra rich, and this is borne out by the discovery of rich floaters lately in the alluvial gully just below the shaft.

Hit or Miss No. 1 S.—In November five tons are reported by the warden as having crushed for only 2 oz. 7 dwt., yet this must have come from the surface.

Hit or Miss No. 1 N.—A shaft has been sunk on a ferruginous quartz; but the mine is now idle.

Johannesburg Line.—"Lord Roberts" was the former title of this reef, and is still the name given to it locally. The outcrop is on a ridge less than half-a-mile north-east of the Four-mile.

Johannesburg P.C.—A blow of quartz here runs 55 or 60 degrees west of north, and in places shows 10 feet of solid stone, poor in gold, however. A shaft is being sunk vertically on the east side of the blow, and has come upon a vein of quartz (scarcely separated from the blow), which is increasing in thickness to thirty-six inches at a depth of 10 feet. The blow apparently dips 60 degrees to the east. The vein quartz is white and compact, splitting into wonderfully sharp flakes; in parts it is stained blue, and is there richest in free gold. In places the stone looks sintery and porous, owing to crystals

and masses of pyrites and galena having been wholly or only partly removed; this galena stone gives good prospects of gold when dollied. Free gold is visible, and small specimens sometimes yield splendid results on dollying.

A shaft, 20 yards south and 10 yards east of the above, struck a reef—probably the same one—at 20 feet depth, but poor in gold, so it was abandoned. The Johannesburg greatly resembles the deposits at the True Blue and Gold Mount, and, for the small amount exposed, the appearances are very encouraging; but a crushing of nine tons in the last quarter of 1900 yielded only 4 oz. 12 dwt. of gold. Galena was seen nowhere else on the field during my inspection; but a specimen of Gold Mount Stone since sent to me carries traces.

Kruger Line.—This is a leader opened out quite lately, and possibly descending to no great depth, but has yet to be proved. The Kruger Numbers have just begun work with no results thus far.

Kruger P.C.—A hundred ounces of gold were found in the alluvial near the present shaft, and later 60 oz. were taken from a vug a couple of feet below. The finder described the gold as occurring in the earth "just like potatoes," and showed me one of the nuggets. It weighed 2½ oz., and was leaf-shaped, even showing a midrib, and was there a quarter of an inch thick. Its peculiar shape is due to the gold having been deposited in a crack. The leader of ironstained bluish quartz from one-half to two inches thick runs north 55 degrees west across the shaft, now 10 feet deep, and dips 30 degrees to the south-west in decayed granite. A greenish "pug" three or four inches thick has given good prospects.

As the owners think the gold is shooting to the north they intend to sink an inclined shaft in that direction irrespective of the dip of the leader, a somewhat unusual thing to do. The occurrence of the pug—possibly a fault flucan—is the most hopeful sign about the vein.

Last Hit Line.—The Last Hit Reef is situated a couple of miles south of Ebagoolah, quite away from other workings.

Last Hit P.C.—A lenticular deposit of quartz about 10 inches thick was worked here till it ran out—this taking place within 10 feet in all directions from the starting point; only four tons of stone were obtained and crushed at the Coen for 23 oz. 11 dwt. of gold to the ton. The country is rotten granite in which the shaft was carried to a depth of 40 feet without again striking the reef.

Last Hit No. 1 N.—A few yards north of the old P.C. Shaft a 10-inch vein of quartz leaders and brown quartzose material carries gold and strikes five degrees west of north. It is almost perpendicular in the trench which, however, has only been excavated to a depth of a few feet. In parts the quartz has a sintery appearance, but the stone where coloured bluish is richest; this blue stone bleaches on heating. The miners themselves have no faith in the reef, but there is no reason why it should not extend to a depth or be found again on sinking if it cuts out.

Luck of Fortune Line.—This lode, it can scarcely be called a reef, is just on the south-eastern edge of the town. The nature of its veinstone is rather puzzling, the evidence rather pointing to its being a mineralised or impregnated crush-zone on a fault. The northern numbers are not being worked.

Luck of Fortune P.C.—The lode varies from two feet six inches to four feet six inches in thickness, and is made up of rotten felspathic and micaceous material carrying quartz veins and leaders. A quartz veined brown felspathic material, disintegrated ferruginous quartz, and a solid pink quartz yield the gold, there being none in the white quartz running through the formation. One veinlet of quartz, carrying a little gold, is near the hanging-wall, and has been continuous from the surface. The gold, which is especially coarse in the smaller veinlets, seems to be in the form of a vertical shoot on the north end of the shaft, there being no free gold in the stone on the south end. On the surface to the south the best floaters were found, pointing to there being other vertical shoots.

At the bottom of the shaft, which is now down to 35 feet, a drive is being opened to the north, and has cut the rich shoot—veinlets and blebs of quartz in a schistose micaceous rock. The absence of gold on the south end of the shaft might be accounted for, in addition to its being just without a shoot, by the reef pinching to a thickness of a couple of inches.

The miners handpick the ore, keeping only quartz-veined stone for the battery. A pound of this, when washed, gave splendid colours, and a handful of the fines from the same paddock also gave good prospects. A sample from the bottom of the shaft and half-way up the north end yielded on assay:—

Gold	2 oz. 5 dwt. 17 gr. per ton
Silver	1 „ 3 „ 12 „ „

The dip of the lode is 70 or 80 degrees to the east, and the strike is 10 or 15 degrees east of north. A decomposed micaceous schist forms the country rock, and near the vein it is sometimes much slickensided; the eastern country is more plainly schistose than that on the west. The footwall is slickensided horizontally, but the hanging-wall is not so distinct.

On the southern border of the claim the lode is exposed in a trench, and is of even greater thickness than in the shaft.

A vein of fine red gossany quartz outcrops about 30 yards west of the shaft, and yields prospects, but it has not yet been tested to any extent. This lies on the west side of a blow of white quartz.

Luck of Fortune No. 1 S.—This claim is on the crest of the ridge bounding Nuggety Gully on the north. Numbers of trenches have been cut, and one pit shows the same schistose quartz-bearing formation as in the prospectors' claim.

Luck of Fortune No. 2 S.—Nuggety Gully lies between this claim and No. 1 S, the gully having been worked up the slope as far as the shaft, where a 13-oz. nugget was discovered, no gold being found beyond. This claim is also known as the Rat.

May Queen Line.—The May Queen Reef is as yet the most persistent on the field, at the surface at least, for it can be traced from the Brilliant, or near it, to beyond the Hit-or-Miss, a distance of three-quarters of a mile. This, the whole line of reef, has been divided into three portions for naming, which,

quite by chance, agree with the changes of its directions, as shown on the map. The first part, the May Queen, runs south-east; the second, as yet unnamed, strikes nearly south; while the third, the Hit-or-Miss line, runs south-south-east. The character of the stone is uniform as far as the Hit-or-Miss claims, where a much more oxidised ore occurs.

The auriferous quartz seems to be undoubtedly a fissure deposit, the fissure having probably followed a bed of quartzite outcropping on the May Queen claims as hungry-looking quartz, and representing an altered bed of carbonaceous sandstone. It is said that the miners only need "backers" to work most of the claims on the line. Very little gold has been found in the gullies east of the May Queen line—in fact, it is said that there is no payable gold on the east nearer than Fox's Lookout.

May Queen P.C.—A whip is used in working the shaft, which is now 85 feet deep, and timbered with frames. The reef strikes north 35 degrees west and dips 85 degrees to the east for 20 feet, then 60 degrees for 30 feet more, and then 50 degrees to the bottom, where there are five feet of compact blue-stained quartz, with scarcely any included country rock. There is, however, a "horse" of country rock 18 inches wide in the reef on the south end of the shaft. Graphite flakes give some of the quartz raised quite a schistose appearance, but it cannot be said from what part of the shaft this comes. A peculiar blue metallic-looking deposit is found in some quantity in the quartz, and yields the best prospects of gold.

A sample of ore taken on the length of the shaft bottom along the hanging-wall chiefly—the portion saved—assays:

Gold	1 oz. 7 dwt. 10 gr. per ton.
Silver	1 „ 2 „ 3 „ „ „

A ton of stone, sent to Dapto last year, returned 2 oz. 10 dwt. of gold and 3 oz. 3 dwt. of silver; and 31½ tons of "firsts," crushed locally in January, yielded 101 oz. 3 dwt. gold. The "seconds" corresponding to the above parcel amount to more than 100 tons.

The country is schist. At the shaft bottom the hanging-wall is plain and has been slickensided, but the slickensides are now partly obliterated.

May Queen No. 1 S.—The veinstone here carries free gold and looks promising, though there is also graphite present in the form of flakes. The shaft, now 30 feet deep on the vein, shows that the dip to the east is gradually decreasing from 55 degrees as depth is obtained. The thickness of the reef varies from three feet to four feet six inches.

A sample from the bottom of the shaft yields—

Gold	10 dwt. 13 gr. per ton.
Silver	15 „ 0 „ „ „

In November last 10½ tons of stone were crushed for a yield of only 2 oz. 19 dwt., and the January returns, a little better, give 27½ tons as crushed for 12 oz. 19 dwt.

Rotten granitic rock forms the country on the west, and does not make a good footwall; the hanging-wall, on the other hand, is a fine, smooth, black, graphitic flucan.

May Queen No. 2 South.—After having been abandoned, this has just been taken up again by a new party. The reef is 6 to 18 inches wide, and dips 50 degrees to the east. Down to the present depth of 18 or 20 feet the reef is said to have here been poor in gold. Near the bottom it appears to be much mineralised, the quartz being firm and to some extent ironstained; a sample from this portion of the reef yields:—

Gold	4 dwt. 14 gr. per ton.
Silver	13 „ 1 „ „

The hanging-wall is well slickensided, and is lined with a blue "dig"; the footwall also is good. The quartz at grass differs in appearance from that in the P.C. Paddock only in being a little more vesicular. The outcrop here is rather white and hungry-looking.

May Queen No. 3 South.—The shaft in this claim is only 10 feet deep, on stone which does not look very promising. Abandoned at present.

May Queen No. 5 South.—In consequence of having no backers, the miners, after sinking a 20-feet shaft, had to abandon the claim, though on gold-bearing quartz. A hard, slate-like rock—possibly a felsite—forms the footwall, a decomposed granite the hanging-wall.

May Queen No. 1 North.—Towards the end of the year this claim was reapplied for by four men. A shaft had opened up the reef to a depth of 30 feet, showing that it dips to the east 60 degrees, and that the vein is, on an average, two feet thick. The strike of the vein is 35 degrees west of north. Most of the quartz seems of poor quality, and that last raised contains much graphite—in fact, more than is to be found anywhere else on the line with rather plentiful blue flucan; it is, therefore, most probably from a bed of quartzite. A pit a few yards south of the shaft shows quartzites dipping steeply to the east in the footwall of the vein.

Oom Paul Line.—The Oom Paul Reef is only a couple of hundred yards south of the All Nations P.C., and makes an angle with its reef of about 40 degrees. The laminated felsites (or altered slates) near it give it a certain amount of resemblance to the Star of Hope Line, though the felsites are much finer grained than on the latter. The mines had been abandoned and could not be inspected.

Oom Paul P.C.—The reef runs north 131 degrees east, and dips east at an angle of 60 degrees. Towards the surface it seems to pinch out. The stone at grass, of which there are half-a-dozen tons, carries no visible free gold. The schistose country forms a good footwall, while on the hanging-wall are a couple of feet of thin-bedded felsite (described elsewhere), dipping with the reef.

Oom Paul No. 1 N.—A shaft on this property, underlying to the east, is 30 feet deep. The ore is a typical blue quartz, but very poor in free gold; the country rock is schist.

Queenslander Line.—The Queenslander Reef runs parallel to the True Blue, already referred to, and only 50 or 60 yards from it; it lies in the south-west angle formed by the True Blue Reef (running north and south), and the reef crossing it in a north-west and south-east direction a quarter of a mile north of the True Blue P.C. Little can be said about the reef, as scarcely any work has yet been done on it.

Queenslander P C.—This claim lies about half-a-mile south of the Tasmania. One pit 10 feet deep has been opened on a vein of fine creamy blue-stained quartz, varying from 20 inches to two feet in width, with good walls in decomposed granite country. North five degrees west is the strike, and the underlie is five to 10 degrees from vertical. In another pit on the north the reef bends a little to the west, but the general course is as above.

Some 20 feet west of this line is another indistinct outcrop from which a small fragment weighing about a pound, chipped off at random in prospecting, yielded very good prospects—certainly good enough for work to be begun on the reef, but the prospectors did no further work there. As far as can be seen, these two reefs run parallel to the True Blue.

Ryan's Line.—This reef runs 20 degrees east of north. A trench has been opened on the left bank of one of the heads of Kendall Creek, a little more than a mile east of Ebagoolah. Very little can be seen, as the trench is only 18 inches deep and a few feet in length. The reef is ironstained somewhat glassy quartz, a couple of feet thick, and dipping at an angle of 50 degrees to the north-west. It is separated by from six inches to two feet of micaceous rock from a buck-reef in the footwall. The reef contains traces of gold. The immediate country on the east is a crumbling white mica granite—very probably a segregation vein or mass, as it quickly yields to schist.

Over the creek on the north-west a dark schist, carrying ilmenite and pink garnet, dips apparently 60 degrees to the south-east. Quartz leaders run through the rock in places, and a band of talcose material a couple of inches thick is said to have yielded colours. Half-a-mile south from here the creek exposes a bed, about four feet thick, of quartz, carrying pyrites, &c., and underlying to the east.

St. Alban's Line.—This line lies on the ridge 500 or 600 yards from the old police camp, across Corbett's Gully.

St. Alban's P.C.—The reef, two feet of ironstained quartz, courses north and south, and underlies to the east 10 degrees from the vertical; a shaft has been sunk on it to a depth of 22 feet. The battery returns for the last quarter of 1900 are: 10 tons 10 cwt., yielding 16 oz. 7 dwt. gold.

Ten feet west of the above is a parallel vein of blue quartz, carrying a little free gold. A specimen from this reef assayed:—

Gold ...	...	...	...	...	...	1 dwt. 23 gr. per ton.
Silver	...	...	...	...	...	5 „ 21 „ „

Star of Hope Line.—The Star of Hope Reef lies about eight miles south of Ebagoolah in a straight line, but to reach it it is necessary to go round through the Four-mile and Ten-mile, covering a distance of something like 13 miles. The occurrence of the porphyry here has been already described. A thin vein of quartz runs along the junction of the bedded and massive porphyries, and, when these make a bend towards the south-west, it leaves them and continues to the south in granite.

Star of Hope P.C.—Keating Claim, as this is more often called, is a promising one. A few pot-holes have been opened on it, only to a depth of a couple of feet, but showing that it dips 85 degrees to the west. At the surface it seems to be about six inches from the massive porphyry. In its northern portion the reef's course is north and south; there are two to six inches of barren white quartz, with two to four inches of blue quartz. Towards the south the vein varies from one inch to two feet in thickness.

Half-a-mile south from where first seen the vein has been trenched; it is 18 inches wide, and still dips west at an angle of 65 degrees. It is there very ferruginous, but carries free gold. A couple of hundred yards north of this point the felsite is replaced by granite as country rock; this, perhaps, explaining the change in the character of the vein material, though it may simply be due to difference of water-level. To the south again from here the reef continues for some hundred yards, and increases in thickness.

Tasmania Line.—This reef lies in a small gully a couple of hundred yards off the track to the Four-mile and 2½ miles from Ebagoolah. Trenching, undertaken because of the rich alluvial patch in the gully below, brought the leader to light.

Tasmania P.C.—A find of 480 oz. of gold within an area of one square yard, and less than four feet from the surface, led to extensive systematic trenching, which has exposed a leader with a somewhat erratic course. A large shaft has been put down on it to a depth of 26 feet, proving it to be from six to nine inches wide, and to have a dip which, like the strike, is rather irregular—sometimes east and sometimes west—but as a whole the vein is vertical. In its upper portion the vein shows free gold, but none near the bottom of the shaft. The manager of the mine thought that the gold-bearing stone pitched as a shoot to the south, and on opening up in that direction he obtained rich stone. The vein where the discovery was made, the manager told me, was two feet wide with solid casings, the gold and sugary quartz being in rounded lumps in a cavity filled with red ochre. The country is biotite granite with laminated quartz.

Trafalgar Line.—The working of the alluvial deposits on the opposite side of Ryan's Creek to the Four-mile Camp led to the discovery of this reef. Very numerous rich "floaters" in the "alluvial" were the indication—the reef itself, like some others on the field, making no great show at the surface. The vein seems to have no considerable horizontal length; at any rate, the "numbers" are not able to find it.

Trafalgar P.C.—On this claim there are two different but parallel veins, striking north 30 degrees west. The shaft on the main but poorer vein is 50 feet deep in a decomposed quartz-veined micaceous country rock; it is vertical for 20 feet, and then underlies 80 degrees to the west. The reef is from three to four feet in thickness.

A sample taken from the bottom (but also containing some of the eastern vein) assayed :—

Gold	...	...	...	1 oz. 9 dwt. 10 gr. per ton.
Silver	...	...	...	12 „ 10 „ „

The ore is a white quartz stained with brown oxide of iron, and shows a few patches of sulphide, and in the paddock most blocks show free gold; it is, however, not free from inclusions of country rock. One stack consists of several tons of "floaters," the boulders being up to 18 inches in diameter, and nearly all carrying gold, appearing on the faces somewhat like gold paper.

A crushing of 52½ tons, including all the specimens found on the claim except 25 oz. dollied, was made during the last quarter of 1900 for a yield of 292 oz. This should not be taken as an average, but a surface yield.

A crosscut driven to the east cut a six-inch leader at 15 feet from the shaft, and this has been worked by two shafts to the south of that on the original reef. This vein dips 65 degrees to the west, and by the shafts strikes 30 degrees west of north. Being richer than the larger vein, it has been worked to a greater extent; the shaft is only 30 feet deep, but from the 20-feet level the vein has been stoped out to the surface.

In the shaft can be seen nine inches of reef, a hanging-wall formation, and a "casing" on the foot-wall. The vein quartz is slickensided horizontally on the footwall side. Copper carbonate stains some of the stone from this vein—an unusual occurrence on the field, though copper can be detected in the ore from different parts. The country rock on the footwall is much more felspathic here than elsewhere on the field. This may very probably be a true fissure deposit.

Trafalgar No. 1 S.—A shaft was sunk to a depth of 50 feet here without cutting the reef, but the cap was found by a crosscut six feet to the east. Another crosscut carried 15 feet to the west was unsuccessful. This is probably the P.C. Leader; but, as the drive had been closed again during sinking, the vein could not be seen.

A sample from the stone raised assays :—

Gold	...	...	...	...	2 oz. 17 dwt. 7 gr. per ton,
Silver	...	...	...	...	1 „ 3 „ 12 „ „ „

The country at the shaft bottom is a rotten mica schist with clay "floors" dipping to the west, but a felspathic rock was first passed through in sinking.

Water is making along cracks at the bottom of the shaft at the rate of 360 gallons an hour. A whip is used for hauling, and ventilation is assisted by a brattice, which also separates the manway from the main hauling compartment.

Trafalgar No. 2 S.—Though the claim is on the course of the P.C. Reef, no reef has yet been found, but bars of gneissic or schistose and felspathic rock were cut. At a depth of 30 feet in the first shaft sunk a drive was opened to the west, and passed through gneiss, pegmatite, and bars of hard granite in rotten granite.

A shallow shaft some distance to the west of the above, but on the strike of the P.C. Reef, has met a green decomposed quartz diorite (already described), with a few veins of segregated felspar, but no sign of a reef. This intrusion may have a connection with the disappearance of the reef, but in any case the cap of the reef seems to be "dropping" or pitching to the south.

Trafalgar No. 1 N.—Little work has been done on this claim, and the reef has not yet been found.

True Blue Line.—A blow in the form of a boomerang stretches south from the Ebagoolah Four-mile track near the Tasmania, and at the southern end of the blow this claim is situated. Steel's Gully, directly below, has been fairly rich, so work was commenced on the blow, or rather on each side of it. The course is 20 degrees west of north from the shaft for about 250 yards, when the reef bends round almost to due north.

True Blue P.C.—The blow here, only about a quarter of a mile from the Queenslander Claim, appears to be twenty feet wide, and has given prospects in the trenches, which have been opened up along its sides, the better results being obtained in the eastern one. A shaft is to be sunk on the east to prospect the blow, which is now giving off leaders rich in gold but patchy. A black slate-like rock, which must be looked upon as a good indication, is coming in on the eastern wall, which, though as yet not very definite, seems to dip to the east at an angle of 80 degrees.

The veinstone looks rather white and hungry, but the patchy leaders in the shaft give wonderfully good prospects when dollied. Scarcely any gold is visible till the stone has been roasted, dollied, and washed through; the specks are then fairly coarse. The country rock is a schist or granite, but, owing to the shallowness of the workings and the rotten condition of the rock, its true nature cannot be told.

May Queen—Hit or Miss Line.—The central portion of this line, being more than a quarter of a mile from the May Queen P.C., was taken up as a prospecting claim, but remained unnamed.

Unnamed P.C.—The next claim south of the May Queen No. 5 S. is at the beginning of the portion of the reef running within 5 degrees of north and south. It was abandoned because the gold-bearing stone, which lasted to a depth of 20 feet, gave way to a hard white quartz. The ore carried pyrites, &c., and looked promising.

Summary.—Taking into account the shallowness and small amount of work done, it would be rather premature to group the reefs into systems—at least, to give a reliable classification—as both strike and dip are continually changing in the same reef, and in some cases the amount of reef visible for taking measurements was very limited. As a matter of fact, the fisures were all probably formed at one period—*i.e.*, during the intrusion of the biotite granite. The zone, spoken of in the beginning, is, as far as evidence goes, a crushed area, both schists and older granite having been affected. The pressure must have existed even after the formation of some of the veins, causing earth movements, as shown by the horizontal slickensides on some of them.

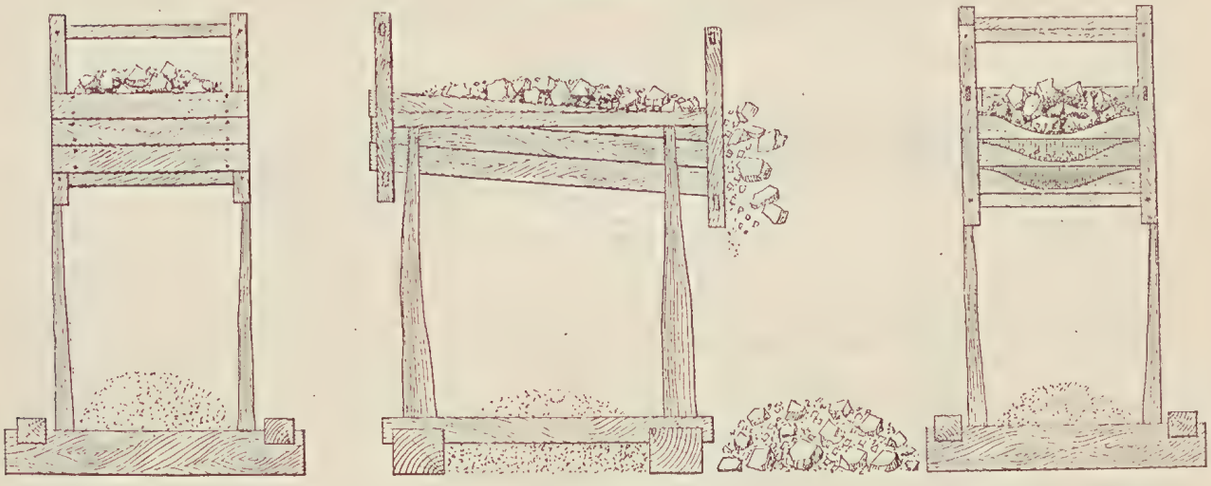
4. ALLUVIAL.

Under the term "alluvial" will be included all gold workings on the field in which the gold is derivative. Of true alluvial auriferous deposits, formed by the mechanical action of streams, there is exceedingly little—so little that it may be neglected.

The alluvial gold deposits of Ebagoolah have been derived from the weathering and breaking-up *in situ* of quartz reefs and leaders, the latter more especially. The country being so flat, the wet season so short, and the amount of rainfall so small, the water that is not absorbed by the parched ground has so little transporting power, that most of the gold remains directly over the stump of the reef; in fact, all the nuggety gold is generally found in a bunch. Fine gold is thought by most of the miners to be absent, so that in their shakers wire screens with more than eight meshes to the linear inch are seldom used, and the finest screen seen on the field was a 16-mesh.

There being only enough water for domestic purposes, washing the alluvial is out of the question, so dry-shakers are used. These consist of a series of superimposed trays mounted on four springy legs. The trays, which have perforated or gauze bottoms, are two feet by two feet six inches, or three feet, and two or three inches deep, sloping one in 10 or 12 and raised about three feet above the ground.

Sketch 3.



Top End View. Side Elevation. Bottom End View.

The top tray has a zinc bottom with half-inch perforations one inch apart, that of the second is a copper wire screen with eight strands to the linear inch, and of the lowest a screen with sixteen strands to the inch. The whole machine as shown in the drawing is very roughly put together, strength and lightness being the only considerations. Stones larger than the perforations are thrown out at the end of the tray; the fine material falling through the last tray is either concentrated by tossing in a dish (dry-blowing), or it is saved for washing. Nearly all the gold is found on the eight-mesh screen as a rule. Shakers now cost about £1 on the field, but at the time of the rush were four times as dear.

A couple of dry-blowers are at work, being very efficient in saving fine gold. These also consist of a series of trays, which in being rocked compress alternately small bellows on opposite sides of the machine, causing a draught to pass up out of the collecting-box through a perforated plate on which the gold and dust falls from the trays above.

A certain amount of panning-off did take place at the beginning of the rush, there being then a series of deep waterholes extending north and south on the west side of the main camp, and forming its water supply. However, these quickly became silted up as a result, and the water, as it gave out, gradually deteriorated till the public well had to be sunk for a domestic supply.

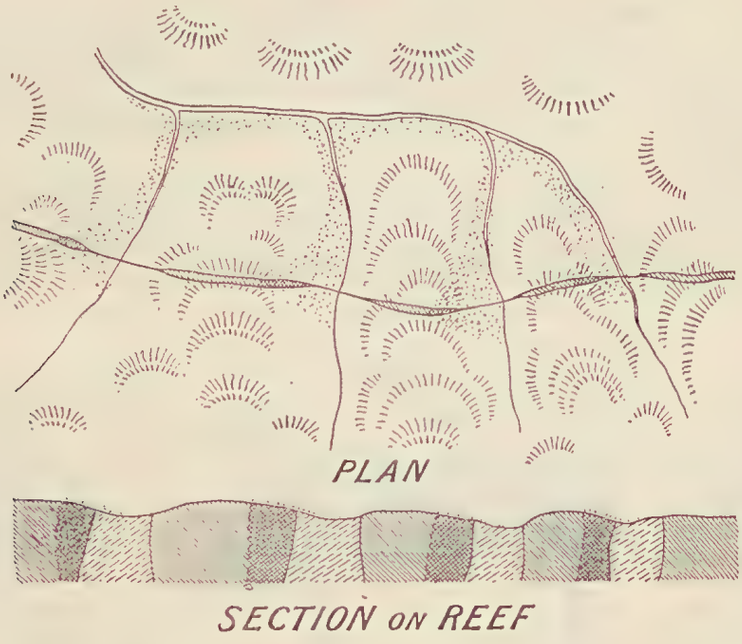
The auriferous deposit consists of angular fragments of quartz mostly less than one quarter of an inch across, but in some places beds of coarse fragments up to nine inches across are found, always loosely cemented by soil, and forming, in fact, a kind of subsoil. It varies from less than an inch to a few feet in thickness. Throughout the alluvial smooth rounded pebbles of ironstone (limonite), up to three quarters of an inch in diameter, are found in great abundance both in rich and poor ground. These pebbles are often penetrated by gold which cannot be detected unless wetted. They most probably are chemically rounded fragments from the veins and leaders in the granite. In a reef in the gully east of the old camp limonite can be seen lining cavities in the quartz, and in places is already half rounded, so there is a possibility that the limonite was also deposited concentrically in cavities of the reefs.

Sometimes the pebbles are found to consist of an outer crust of hard brown limonite, with yellow ochre in the centre, which would point to their being concretions. However, it is also probable that percolating rain waters have assisted in rounding off any angles, as sometimes grains of quartz or other mineral are seen projecting from the pebble. The overburden consists of a clayey soil, formed by the weathering of granite, and its thickness is from less than a foot to over six feet.

On the map only areas which have been worked are coloured. It is strange that these workings are always on the northern sides of the gullies. Miners say that the slopes facing the north are poor both in alluvial and in gold, but they acknowledge that these slopes have not been thoroughly prospected; a couple of men have lately been trying, apparently with success, the southern side of Dickie's Gully. The lenticular nature of the quartz reefs, together with the direction from which rain comes, may have

had something to do with the formation of gullies on the nodes of the reefs. The reefs themselves would cause ridges (across which, in this case they cut), and if gold were more plentiful in the southern portion of one lens it might be so in the others. (*See Sketch* 4.)

Sketch 4.



The extent of the alluvial is hard to define. Prospector Dickie will affirm that there is gold in almost every gully on the field, but he does not attempt to save it. The country north-east of Ebagoolah agrees with it in all particulars, ironstone pebble ridges abounding, and gold has been reported from the granite country about Fox's Lookout, in this direction. East of the town gold seems to be scarce, and south-east of the Four-mile there is no sign of it. On the road to Coen—*i.e.*, to the north—a little similar country to that being worked at Ebagoolah is passed over, but to the west the rocks differ quite from those about the camp.

The alluvial in Ebagoolah is practically worked out, though they talk of washing the whole when rain comes. Prospecting towards the end of last year was almost impossible, there being no water, so that a man would have to return to one of the camps every night; but prospecting may open up a large tract. Gold is constantly reported to exist "down on the Coleman"—presumably some 25 miles south-east of Ebagoolah, and a rush would in all likelihood have taken place before Christmas if there had been water available then.

Estimates of the amount of alluvial gold won up to November last vary from 6,000 to 12,000 oz.—the former being the actual amount which had passed through the banks.

Non-auriferous "cement" deposits occur on the granite half-a-dozen miles east of Ebagoolah.

The alluvial areas will be taken in order from north to south.

Dunwich Gully.—Dunwich Gully is less than half-a-mile long, and runs to the east from the north end of the town, draining the town ridge and the southern side of Hospital Hill. It has the reputation of being the poorest gully worked on the field, there being from two to six feet of overburden (soil) above the gold-bearing deposit, which consists of small angular and subangular fragments of quartz with rounded ironstone pebbles. The deposit varies from a few inches to little more than a foot in thickness. The bed rock half way down the gully is a muscovite granite, but below this are schists. A fair amount of work has been done almost wholly on the left side of the creek, but not more than a few yards from it. Fragments of ilmenite, slightly magnetic, have been washed from Meyer's Claim in the gully. Only one man is now working here.

Jackson's Gully.—Jackson's Gully runs in the same direction as Dunwich Gully from the south end of the town, the total length being less than 600 yards. The alluvial has been worked on the lower 400 yards for a distance of 50 or 100 yards from the gutter up the northern slope only—the chief workings being near the gutter. At the lower end the tongue of land on the southern side between it and Nuggety Gully has also been worked.

There are some ten men working in the gully now. A party of four men are in one part working up the gully. Two of them take a strip of ground 10 feet wide, and work forward for 12 feet, stripping down the soil and subsoil with hoe and shovel, and building a wall with the larger pieces, behind which the loose dirt is thrown. Then two others begin—one picking the wash loose and working the shaker, while the other breaks up the wash and shovels it on to the machine. The eight-mesh screen is the finest used in the dry shakers, as there is very little fine gold.

On the south side of the gully the soil is more clayey, and difficult to work by the shaker, so has not yet been fairly tried.

Nuggety Gully.—Nuggety Gully is the head of the creek on to which the above two gullies open, and has here a north-easterly direction, being separated by a single ridge from Jackson's Gully. An area, 300 yards long and 150 yards wide, has been turned over. The number of men on it is never constant, as many as twenty being at work with shakers sometimes. The alluvial, from two inches to two feet thick, is, as usual, covered with from six inches to four feet of soil, the thickest covering being near the creek. Nicol's Claim, from which he obtained 1,200 oz. of gold, was near the creek, but covered with only 18 inches of soil; it was at the lower end of a "run" of gold, followed down the slope. A very few nuggets have been found scattered over the hillside. Unfortunately, in stripping the ground, leaders were not looked for. The southern side of the gully has not been worked.

Looking-Glass Hill.—Looking-glass Hill is the northern side of Peterson's Gully, lying midway between the old and new camps. The track to Ebagoolah passes up this slope beside the workings, which cover an area about a-quarter of a mile long and a-quarter of a mile broad. The slope is from 1 in 100 to 1 in 50.

The soil on the hill is nowhere of any thickness, three feet being the greatest, and as almost the whole of the alluvial, varying from three inches up to two feet, has been turned over, it must have been fairly remunerative. The alluvial consists of clayey material containing angular fragments of quartz up to nine inches in diameter, with abundant grains of limonite up to three-quarters of an inch across, and often with a centre of yellow oxide.

A rotten muscovite granite forms the bed rock. Only one leader (the Kruger) has been found, and this could not possibly have been the parent of all gold found on the hill side, as it lies on one side of the area. Ten or twenty men are always at work here.

Peterson's Gully.—Peterson's Gully, above Looking-glass Hill and below where the track crosses it, has been worked to a small extent for gold, the deposit in this case being on the gutter and probably true alluvial.

Dickie's P.C. Gully.—The P.C. Gully is a small hollow between the old post office and police camp. Dickie says he tried the alluvial just below the outcrop of quartz already described, and that, on packing the dirt to some lagoons a mile to the north, he found colours in the first dish washed, but he only obtained a couple of ounces more for a fortnight's work. After reporting the find he soon sold out, and it was then worked by shakers, the dirt put through being stacked behind to be washed in the wet season. A few nuggets and a little gold were found in the gutter as a result.

Dick's Gully.—The head of Peterson's Gully, known as Dick's Gully, has been worked to some extent on the west side of the creek, where the country is a metamorphosed granite. Much of the gold from the place was angular and coated with ironstone. The alluvial along the creek has also been worked.

Slaughteryard Gully.—This gully, on the eastern side of the old camp, runs in a northerly direction. Pot holes have been dug all along the course of the gutter, but no considerable workings have been undertaken in it. The country here is a coarse weathered granite, through which cut quartz veins carrying limonite.

Corbett's Gully.—Corbett's Gully is a slight depression on the east side of the ridge running south from the old camp. Most of the gold has been obtained from a portion fifty yards square, but it has been worked for a width of 200 yards. Though of such small extent, this has been one of the richest parts in nuggets, which lay almost on the surface; in fact, the first nuggets were actually on the surface, but were not found till some time after the opening of the field, although the track from the south passes right through the gully. Dry-blowers were trying the alluvial when we came away.

Hit or Miss Gully.—Several men have been lately hard at work on the small gully below the Hit or Miss P.C. Rich floaters were found on that claim near the shaft, and just now the miners seem to be attending more to the alluvial than to the reef.

Good Luck Gully.—The banks of the creek running south-west from the ridges near the old camp and past the Good Luck P.C., have been worked in an incomplete manner, the prospects having evidently not been very good.

Ross' Well Gully.—The flat above Ross' Well, a couple of miles south-east of the old township, appears to have been prospected, there being numerous potholes over it.

Tasmania (or Golden) Gully.—Alluvial was worked here with profit before the reef was discovered, and is still in a desultory fashion along the creek chiefly. Evidently from the heaps of rubble the deposit must have been of some thickness here, though only a few yards wide.

Queenslander Gully.—A short distance from the reefing claim are alluvial workings of small extent, in which 50 oz. were found above a little leader which, however, cut out without yielding any gold.

Steel's Gully.—Steel's Gully lies some three miles south-east of Ebagoolah, at the end of the True Blue Quartz Blow. It is reported that it yielded payable fine floater gold and a few small nuggets, and rumours are persistent that much gold has been taken south from this gully without the knowledge of the general public. Some gold from all the finds is, of course, secreted, but the isolated position of this gully enables the finders the easier to carry it away without other miners knowing of it. Miners working in Steel's Gully camp there, but have to walk to Ryan's Creek for water.

The Four-mile.—The Four-mile is a camp on Ryan's Creek, and the track from Laura passes through it to Ebagoolah. A large (comparatively speaking) alluvial flat has been worked here by shafts, the overburden being too great to be stripped. One of the claims is still worked spasmodically, the gold being far too patchy to induce miners to work at it constantly.

Two little creeks, just below the camp, one on the right and the other on the left bank, have been worked—true alluvial.

Croydon King Gully.—A couple of miners here are on a small area of alluvial, which is from three inches to one foot thick, and rather poor in gold, but covered by only a couple of feet of soil.

Gold Mount Gullies.—These gullies still give uncertain employment to a few men.

5. METHODS OF WORKING AND MACHINERY.

With regard to the methods of working much need not be said, as they differ in no respects from those on other new fields. Untimbered shafts are the rule, being sunk rather for prospecting than as permanent main entrances. Owing to the rotten state of the country rock all over the field, it is expected that most of the shafts will cave-in during the wet season, for, with one or two exceptions, even frames have been omitted, not to mention lining.

In the case of reefs leaning from the vertical, shafts are always sunk on the underlie, and it is absolutely necessary then to use frames, but in no cases have they been lined. Before Christmas, however, a few parties were preparing to line their shafts for the wet season. Slats seven feet long will be used for this purpose, costing £2 per 100 for splitting and £2 for cartage.

It is reported that in the earlier portion of the year very little work was done on a reef as soon as it was found to carry gold, the miners hoping to be able to sell it before development had perhaps proved it to be a "duffer." The owner of a battery now on the Coen Field was deterred from erecting it here simply by this lack of confidence of the miners themselves in the field.

Shafts are generally sunk to the water-level, and then drives are carried along the reef, and stoping is begun for funds. In some cases exploratory crosscuts are driven for a short distance into the country, resulting at times in the discovery of leaders, as at the Caledonia and Trafalgar P.Cs. In all cases the shafts are fair-sized, about six feet by three or more, this being rendered easy by the soft nature of the country rock. The brace is made of six-inch round timber, built up in pigsty fashion, and lined with one-inch planks six inches wide and four feet long. As regards winding and hauling, windlasses are employed at all the mines except two, where whips have been erected. Greenhide buckets are used in the great majority of claims, the casks which are seen in some mines being only procurable with great difficulty. In one or two of the prospecting shafts the descent has to be made in these buckets or in a loop on the end of the rope; in a few others are Jacob Ladders, consisting of a single upright in which rungs are fixed, but in most of the shafts strong ladders of the ordinary type are securely placed.

A five-head stamper battery is the sole representative of mining machinery on the field. Beyond the copper plates there are no gold-saving appliances, so it stands to reason that much gold is lost. The site for the battery, which is about four miles east of the old camp, was chosen before the sinking of the public well and before water had been struck on the Caledonian Line, the few rocky waterholes appearing to be the only permanent water in the district. This water quickly gave out when the battery commenced work, and the holes in any case would be soon silted up unless scouring took place during thunderstorms. It is now agreed that a more central position is imperative, the present site being quite away from all the mines, and, in addition, the country intervening is deplorably sandy, causing great increase in the cost of cartage, which, from some of the mines, will be as much as 30s. per ton. The cost of crushing is 30s. per ton.

6. CONCLUSIONS.

Past work on the Hamilton Field has of course been greatly hindered by want of water, last year's wet season having been a partial failure. Prospecting on an extensive scale outside of the actual camps has been wholly out of the question when neither water nor grass was to be procured. Very little washing of the alluvial could be done, even about the camps, because of the small supply of water there, and thus almost all the alluvial gold hitherto obtained is due to the dry-shakers and blowers.

Early work on the reefs was not of a very energetic character, this most likely being due to the absence of a battery and the system of "backing" other men, then necessarily in vogue, in addition to the desire to sell the mine while making a good surface show. The storekeepers on the field have backed numbers of men, and many reefs have been tested which otherwise would have remained unworked; but it is well known that men when "backed" tend, if not supervised, to shirk their duties, being independent of the product of the mine.

The erection of the battery, it goes without saying, gave a new impetus to work, and with the crushings further exploitation will now be possible, for, owing to the practical exhaustion of the alluvial in the vicinity of the camps and the long period through which the reefs had to be "backed" with no return, things were beginning to look serious in the later months of the year.

The crushings made, while being in no way extraordinary for surface stone, give promise that the Hamilton will be a permanent reefing field..

THE COEN GOLD FIELD.

The Coen Gold Field, by *Gazette* notice of 16th August, 1892, included an area of forty-three square miles, which was increased to 187 square miles on 16th June, 1898.

According to the run map of Cape York Peninsula the Coen Telegraph Station is in longitude 143 degrees 12½ minutes east and latitude 13 degrees 4½ minutes south. As the crow flies it is 33 miles from Port Stewart and 21 miles from Ebagoolah. It is situated on the Coen River just above its junction with the Llankelly Creek, which flows from the east. The township, consisting of some 30 galvanised-iron houses, lies along the left bank of the Llankelly and the river below it in a rather scattered state. The normal population of the town is about 150, but the discovery of the Hamilton Field last Christmas (*i.e.*, 1899-1900) caused a "rush" there of almost all the men.

The field includes three mining centres—viz., the Coen proper, the Springs, and the Klondyke. The Springs Camp is about nine miles south-east from the Coen Telegraph Station, and lies on eastern waters—*i.e.*, on a tributary of the Stewart River. There were never more than 20 men here, but now there are only half-a-dozen. Klondyke Camp is about eight miles from the Springs in a north-easterly direction, and the population may be 10.

About the Coen the country is exceedingly hilly, the ranges, such as the McIlwraith and Geikie, probably having an elevation of 2,000 feet, while Mount White, a solitary hill a couple of miles south of the Coen Township, rises 760 feet above the flats at its base. These flats extend along the river to the town, and are bounded on the east by the McIlwraith Range, opposite the Geikie Range on the west. Isolated hills are usually conical and the lower ranges razorbacks; and cross sections of all small gullies are sharply V-shaped, contrasting with those on the Hamilton, where a gully is simply a depression in the warped surface. Watercourses are all dry just now, owing to last rainy season having failed, and, though chiefly sandy, they show a good number of exposures of rock.

Dr. (then Mr.) Jack* first reached the Coen in September, 1879, when on an exploring expedition in the Peninsula. In his report he gives particulars of the discovery of gold, and states that the first rush took place in February, 1878, and that the field was abandoned in July of the same year. His men, set to wash the river sand, proved it to be unpayable for about 10 miles above the present town. Dr. Jack visited the old Two-mile workings and found the country above them to be mica schist. The party also proceeded up Shanty Creek (now called the Llankelly) for five miles to some old workings, the wash in which had been very poor.

On account of the long land-carriage from Cooktown, the inferiority of the gold, and the small amount present in the wash, Dr. Jack came to the conclusion that the alluvial diggings of the Coen would not employ white men at a remunerative rate, though they might pay Chinese Labour. (On trial in 1880, however, the Chinamen who then tried them found they could not work them with profit.) Nevertheless he thought the quartz reefs might pay to work if machinery were on the spot.

REEFS.

These may be considered for each camp under the following heads:—(*a*) those being worked, (*b*) those temporarily abandoned, and (*c*) those abandoned altogether.

At the Coen only one line is being worked; it runs right into the town, and on it are the Stockholm, Abdalla (and Victoria), the Great Northern, and Great Northern No. 1 South. Mines that will in all probability be soon taken up again are the Daisy and perhaps the Long Tunnel. Totally abandoned mines are the Wilson, Hanging Rock, Homeward Bound, and Trafalgar. At the Springs the Westralia and Goolha-Goolha are working, while the Rothwell and Sirdar are likely to be again taken up. At the Klondyke Camp the only mine working is the Springfield P.C., but the numbers on the same line will very probably be taken up as soon as the battery starts work.

(*a*) Stockholm.—This was the first claim applied for on the field. It is only a few hundred yards south-west of the centre of the township. The reef runs north 40 degrees west, and is vertical for 20 feet or so. Then it underlies 30 degrees to the south-west almost to the bottom, where it seems to be again becoming vertical. It is reported to have been very rich at the surface, the normal gold-bearing vein coming in on the footwall at a depth of 60 or 70 feet. The shaft is now 125 feet deep, and the amount of gold has suddenly diminished without any change in the reef. The best gold was, strange to say, in the underlying portions. Water is now "making" and rendering the walls dangerous and rotten. The direction of the Abdalla Shaft (the next on the south and some 150 yards off) is 121 degrees east of north from here, so there must be a bend or fault between the two mines if they are on the same reef.

The stone on the mullock heap is scarcely distinguishable from that in the paddock, but apparently the former is traversed by more defined veinlets of quartz than the latter. As the stone at the bottom where the reef is a couple of feet wide is acknowledged to be unusually poor, and as it was not possible to get at the sides, I took a surface sample from the 50 tons of ore at grass, which has all come from the shaft.

The result of assay is—

Gold—A trace only (*i.e.*, less than 16 gr. per ton).
Silver—2 dwt. 14 gr. per ton.

Such a small content is unaccountable unless the stone collected was entirely from the shaft bottom. A crushing of 32 tons in July, 1900, gave 125 oz., and one of 76 tons in 1894 yielded 223 oz., but these must have been picked.

There are numbers of shallow trenches between the Stockholm and the township, said to have been opened on very rich leaders which, however, quickly cut out.

Abdalla and Victoria.—Though there are two shafts on this property, it having been formerly a separate lease and claim, the mine is exploited by a single shaft, which is well timbered with frames, underlies at an angle of 20 degrees to the south-west, is 190 feet deep, and is worked by a one-horse whim, of which the drum is eight feet in diameter and the driving arms 15 feet in radius. A quarter-inch steel wire rope is used with large casks for winding the material from below. The poppet frame is of wood, and the brace is provided with light iron railways for trucking away the mullock and ore.

On the surface the reef runs north 30 degrees west, but at the 80-feet level its course is north 50 degrees west. It pinches out at 160 feet depth on the south end of the shaft, and at 170 feet on the north end, and now at the bottom of the shaft is a bluish non-auriferous but mineralised (*i.e.* pyritous) quartz. From where the reef cut out it was stoped to the surface on the south side, the reef being three to five feet thick, with a fairly well-defined but rough footwall of bluish quartzose slate [*see Appendix B* (4)]. The mainway at the bottom of the mullocked-up stope is continued to the Victoria Shaft, distant some 75 feet. In the shaft the hanging-wall is well-defined with much slickensided bluish plumbago clay selvage, but the footwall, as a rule, is not distinct.

A drive at the 164-feet level proves the reef to the north for 30 feet, though it is absent on the south side of the shaft. At the 80-feet level is a tunnel to the north for 100 feet, the average width of the vein being at least four feet, but it is rather poor in gold. All the ore above this drive has been stoped out to the surface.

The vein appears to be on a true fissure, so that, though it has cut out, there is every possibility of its being struck on sinking (as was the case in the Great Northern).

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* Report of Explorations in C. York Pen., 1879-1880. R. L. Jack, Govt. Geologist. By Authority: Brisbane.

The battery returns show that there is nothing extraordinary about the mine, the average results, given me by the Warden, being less than one ounce per ton last year—

1899—May	68 tons	for 47 oz.	gold
July	217	„ 125	„
August	103	„ 109	„
September	6	„ 24	„
„	120	„ 108	„
October	27	„ 36	„
„	6	„ 10	„

From Acting-wardens' Reports—

1894 to 1896	672 tons	for 1,750 oz.	gold.
1897	138	„ 551	„
1898	272½	„ 854½	„
1899	457	„ 429	„

The returns for the same years from the Victoria Claim are:—

1894 to 1896	1428 tons	for 1419 oz.	of gold
1897	207 „	358 „	„
1898	522 „	561½ „	„
1899	438 „	384 „	„

These show that the value of the ore is gradually decreasing. There are 50 tons of ore at grass, from which a surface sample yields, on assay:

Gold	5 dwt. 21 gr. per ton
Silver	7 „ 4 „ „ „

About 50 yards east of the mine is an outcrop of granite, which may have been connected with the formation of the vein, but is more probably an altered rock. The reef does not, in this mine, strike towards the Stockholm, but the miners (who have prospected the ground) are firmly convinced that the Stockholm, Abdalla, and Great Northern are all on the same reef.

In January the reef was reported to have been cut again at 270 feet depth, and to be three feet wide, but to carry no gold.

Great Northern P.C.—Within 75 yards of the Abdalla, this shaft lies north 137 degrees east from it; a one-horse whim and a three-quarter-inch steel wire rope are used for winding the buckets. Light steel rails are laid in the mine and on the brace. The shaft is now 250 feet deep; there is a level 130 feet long on the north at 80 feet depth, and levels—one north 43 feet and one south 135 feet long—at 180 feet depth. There are also levels north and south at 164 feet depth.

At the surface the vein strikes north 158 degrees east; it is almost vertical for about 30 feet, and then underlies 30 degrees to the south-west. A blue slate-like rock, with white chalcedonic veins and veinlets running through it, forms the reef material, and averages 18 inches in thickness. The auriferous vein in this claim is on the hanging-wall, but towards the No. 1 S. it cuts out, another vein making at the same time on the footwall. The hanging-wall is generally good, and throughout the footwall is splendid. The country is a bluish slate [*see Appendix B* (13)]; and adjacent to the reef on the hanging-wall is a compact greenish, flinty eurite which is non-auriferous. [*See Appendix B* (14).]

At the 180-feet level the lode decreases in size towards the south, and in working towards the surface it was found to become poorer also; but to the north the vein is five or six feet thick, and was stoped for 30 feet from the shaft up to the 80-feet level—crushing for 2 oz. per ton. At the bottom of the shaft coarse moss gold has been obtained, but it is very pale.

A sample from the north and south 164-feet levels, the bottom of the shaft, and the stope in No. 1 S. assayed:—

Gold	2 oz. 1 dwt. 19 gr. per ton.
Silver	2 „ 4 „ 10 „ „

The Great Northern is undoubtedly a fine reef, and everything points to its being a true fissure vein. The gold certainly is poor in quality and may be a little patchy, but the last seven crushings (*i.e.* for 1899 and 1900) amounting to almost 1,200 tons, gave an average of 3¼ oz. per ton. The yearly returns as furnished to the warden are—

1894 to 1895	1,058 tons	gave 2,005	oz. gold.
1896	520 „	„ 1,928	„ „
1897	824 „	„ 965	„ „
1898	395 „	„ 976	„ „
1899	528 „	„ 1,548	„ „

At present the chief work is sinking. There are 250 tons of ore at grass from which 3 oz. gold per ton are expected.

Great Northern No. 1 S.—These people use the P.C. Shaft, having come to an agreement with the proprietors of it, who are mostly shareholders in the No. 1 S. At the 80-feet level the walls are five feet apart, but most of the included material is the non-auriferous greenish flinty felsite. The reef is pinching out altogether to the south at about 100 feet from the prospecting claim, but the footwall is still very well defined.

Stoping has been commenced from the 180-feet level at the prospecting claim boundary, but very much work has not yet been done. In the stope the reef is 15 or 18 inches wide. For assay of sample see under the prospecting claim (only one sample having been taken for the two), and, for a description of the hanging-wall rock, see *Appendix B* (14).

(*b*) Daisy.—The Daisy lies about a mile due east of the Telegraph Station and some 500 yards north-east of the Great Northern. As the mine was flooded, an inspection underground could not be made. However, the country rock is a granite, consisting of quartz, dark mica, and pinite [*see Appendix B* (5 and 6)], showing slickensided surfaces. White, blue, and purple fluorspar is abundant on the mullock heaps, with calcite, pyrites, and quartz.

One block found on the heaps was nine inches wide, and may be taken to represent the formation of the lode at one point; it had quartz and pinite on the walls, then a little striated calcite with some dark mineral, and in the centre a mixture of quartz and pyrites. In sinking, a belt of slate impregnated with pyrites [*see Appendix B* (10 and 11)] was passed through. To judge by the size of the mullock heaps, a good deal of work has been done at this mine.

Below are the Warden's Returns :—

During 1894	48½	tons yielded	255 oz. gold.
„ 1895 and 1896	227½	„ „	672 „ „
„ 1897	89	„ „	214 „ „
„ 1898	10	„ „	13 „ „

Long Tunnel.—This has been put into the western side of a ridge about 2½ miles south-south-east of the township to cut a reef which outcrops on the crest of the ridge, and runs about north and south. The country rock near the mouth of the tunnel is a mica schist, but on the summit of the ridge, a couple of hundred feet above and about 300 to the crest, the country is schistose quartzite.

The reef crops out like a blow, but scarcely any work has been done there. A padlocked door at the mouth of the tunnel prevents entrance. About 50 tons of ore lie at grass, from which specimens show that the vein must be nine inches wide in places (though, of course, perhaps wider elsewhere), and that it consists of quartz stained with plumbago-like material, besides holding much arsenical pyrites, and pinite, with pseudomorphs of barytes (?) in quartz.

A surface sample taken from the 50 tons gave :—

Gold	3 dwt. 6 gr. per ton
Silver	6 „ 11 „ „

This may possibly be a segregation vein, but not nearly sufficient data were obtainable for a definite assertion. A crushing in April, 1898, of 44 tons gave 1¾ oz. per ton.

The total stone crushed in—

1896 was	232 tons for 224 oz. gold
1897	552 „ „ 702 „ „
1898	69 „ „ 83 „ „

(*c*) Wilson.—Eleven years ago the mine, it is reported, was abandoned after being worked for three or four years by a company employing forty men. The company is said to have expended £30,000 on the property, and to have reached a depth of 400 feet. It is said also that the yield was never greater than one half ounce per ton, but sinking was carried on in the hope of an increase. The country rock is a schist dipping to the south-west, and the vein, striking 30 degrees west of north, consists of a mispickel-bearing quartz. Work was carried on to a slight extent by open cut, but, the sides having fallen in, very little can be seen. At the north-western end of the cut the vein seems to expand into a blow, while at the opposite end, in some underground stopes, it varies from six to eight inches in thickness, tapering out to the surface. The main shaft is vertical and 15 feet south-east of the lode. All timbering has been burnt out, leaving a six-inch pump pipe and an iron bob still standing.

There are several deserted underlie shafts still further along the outcrop to the north-west, and all yielded mispickel quartz, but they are all falling in. Outcropping on the hills about here are great numbers of reefs or leaders, and where trenched they show mispickel stone. From one of these two men sent six tons to the battery in July, 1899, for a return of three ounces of gold per ton, but it was probably picked stone, as nothing more than surface trenching has been done about here.

The yield for these Wilson Claims is given below (obtained from the Acting Warden) :—

From 1894 to 1897	694 tons	... ...	yielded 503 oz.
In 1898	90 „	... ...	„ 84½ „
„ 1899	425 „	... ...	„ 228 „

Whether these figures refer to the claims on the Wilson Line itself or those in the neighbourhood is not stated.

Hanging Rock.—The country rock here is a beautiful hard grey porphyritic granite [*see Appendix B* (4)], which towards the Telegraph Station passes into a quickly decomposing and possibly metamorphic granite. The vein matrix is an arsenopyrite-bearing quartz. By the shafts the vein courses 170 degrees east of north, and dips about 60 degrees to the north. The shafts are now in too unsafe a condition to be descended, and nothing of the vein can be seen on the surface, but it is said to be small. The hillside above the mine has been worked extensively by trenches on leaders running apparently in all directions. The mine lies about a mile and a-half from the Telegraph Station, in a direction 20 degrees east of north.

Crushings are :—

4 tons in March, 1899	giving 19¾ oz. per ton
5 „ „ September, 1899	„ 14 „ „
2 „ „ June, 1900	„ 7½ „ „

Though these crushings are high, the small vein in the hard granite could not perhaps be profitably worked, but the abandonment may have been caused by the allurements of the Hamilton Field.

Homeward Bound.—The Homeward Bound is situated on the cap of the ridge on whose western flanks is the Hanging Rock, and it is about a mile distant from the Telegraph Station in a north-easterly direction. The ore is mispickel quartz, and seems to occur in a bed of slate, running north and south for some miles from the Great Northern, and separating two distinct kinds of granite, one [*see Appendix B* (4)] weathering easily and without "kernels," the other slowly and with "kernels," so that the ridge has the western side convex and the eastern concave—a slate outcrop running along the top. A large amount of trenching has been done to the north. Here again the shaft was not to be trusted, the mine having been deserted for some time, so the vein could not be seen, but the shaft underlies to the east.

In June 1899 a crushing of 11 tons yielded	4 oz. per ton
And during 1894 to 1897, inclusive, 287 tons were crushed for ...	825 oz.

Llankelly.—This mine lies three-quarters of a mile east of the Telegraph Station on a high bluff south of the Llankelly Creek, and is on an outcrop of slate which weathers into slabs—probably the same outcrop as that on which is the Homeward Bound [*see Appendix B* (9)]. The country on the

west is a metamorphic biotite granite, while that on the east is the Daisy Granite, of an altogether different character. Part of the slate is strongly impregnated with pyrites. Quartz, carrying arsenopyrite, forms the reef, but there were no ladders in the shaft which underlies to the east and has partly fallen in, so that the vein itself could not be seen.

The following are the Warden's Returns:—Five tons in February, 1899, yielded 1½ oz. per ton; then the Eureka Claim in 1899 crushed 202 tons for 570 oz., 31 tons in 1898 for 38½ oz., and 31 tons in 1897 for 112 oz. The yield from the line in 1894 was 490 oz. from 153 tons.

Trafalgar.—This lease lies in the gully just below the Long Tunnel, and within 100 yards of it, but on a different reef. The country rock is schist and the ore is a mispickel quartz. At present the mine is flooded.

During 1897 and 1898, 161 tons were crushed in seven lots and yielded at an average rate of 3 oz. per ton, but there was a falling off from 4 oz., 5 oz., and 6 oz. per ton in 1897 to 1¾ oz. per ton in 1898. The Warden's Returns are:—

1895	167	tons	yielded	531 oz. gold
1896	203½	„	„	678 „ „
1897	94	„	„	328 „ „
1898	48	„	„	74 „ „

The average value of the gold was £3 per oz.

Lady Mary.—The Lady Mary is an abandoned claim a short distance south of the Great Northern.

In 1898, 49 tons were crushed for 127 oz., previous crushing amounting to 41 tons, which yielded 127 oz. gold.

Below are the mines at the Springs:—

(*a*) Westralia.—Situated on the southern slopes of a lofty hill at an elevation of 1,100 feet, and six miles from Mount White in a direction north 121 degrees east. The mine is only about half-a-mile north-west of the Springs battery.

Just on the surface the vein seems to have been thrown in all directions; over a number of square yards it dipped at an angle of 30 degrees to the west (*i.e.*, out from the hill), and the 20 tons obtained ran two ounces per ton. About 20 feet in the hillside, in a decomposed mica rock, the vein is nine inches or one foot wide, and dips at an angle of 45 degrees to the north-west. An underlie shaft has been put down 50 feet from this tunnel, and a vertical uprise carried to the surface 10 feet above. Unfortunately the shaft being untimbered was in a state of collapse; but the miners say the leaders, seen a short way down the shaft to be from two to four inches wide, unite below to form a reef 18 inches in width. The footwall is a splendid one, and deeply scored with slickensides. Here a blue quartz forms the lode material.

At 10 feet below the first drive another has been put a few yards into the hillside; but the lode varies there greatly, giving out completely, and then making again. Granite is the general country rock; but a lot of glassy quartzite occurs near the reef.

Ten feet again lower down is another short drive, from which a shaft has been sunk on the underlie for 80 feet, the inclination quickly increasing from 45 degrees. All the way down the reef occurs as lenticular patches up to four feet in thickness.

At the base of the hill, 200 or 300 feet below, a tunnel has been driven in 380 feet, passing through 70 feet of decomposed granite, 50 feet of the same rock with quartz veins, and 150 feet of parallel quartz veins in decomposed rock. A fissure occurs at 300 feet, and another at 380 feet, where it was expected to strike the reef, and then work was stopped. The tunnel is rather wet.

Five tons, crushed in August, 1899, gave 18¾ oz. per ton, and a couple of hundred tons from the main shaft stopes now lie at the battery. A sample was taken from the two lower drives and from the surface of this heap, showing on assay—

Gold	2 oz. 16 dwt. 4 gr. per ton.
Silver	13 „ 1 „ „

It seemed at first that this might be a segregation vein; but the fine footwall and the regular manner in which the ore deposits occur point to its being a true fissure reef.

Westralia No. 1 S.—A tunnel is being driven into the hillside, but the reef has not yet been struck.

Goolha-Goolha.—As yet this reef is simply being prospected. It lies on the south slope of a hill from which the Westralia lies in a direction 107 degrees east of north, and a couple of miles distant. The auriferous portion of the reef varies from two inches (where there is some mineral, partly galena) to four feet (the best dollyings being obtained from the unmineralised portion). It runs in a direction 12 degrees east of north, and dips steeply to the east. On the hanging-wall is quartzite, while on the footwall is a schistose quartz. All work thus far has been on trenches, proving the lode for 100 yards at least. To the north, 150 yards or so, a reef reaches the surface and runs parallel to the above, but lies some 20 yards west of it.

A sample taken from the whole line of lode, including that to the north, which is probably the same reef, gave, on assay:—

Gold	3 dwt. 22 gr. per ton.
Silver	7 dwt. 20 gr. „

(*b*) Rothwell.—Unfortunately, I missed seeing this mine by mistaking another for it. It lies in a gully a couple of miles back towards the Coen from the Springs and half-a-mile above the track. They say it has been worked profitably down to the mineralised stone and then abandoned. Between the end of 1894 and the middle of 1895, 21 tons of stone were crushed for an average of 1¾ oz. per ton. Lately private assays have been made of this mineralised stone, and such good results are said to have been obtained that the mine is to be reopened in a short time.

Sirdar.—This mine lies a couple of miles south-east of the Springs. It was taken up in 1898, when eight tons of surface stone yielded 13 oz. of gold. A crushing of 90 tons in October, 1899, yielded 294 oz., and there are now 50 tons at the Springs waiting to be crushed. The claim was abandoned, probably, for the Hamilton, at the time of the rush.

Now, to take the mines at the Klondyke :—

(*a*) Springfield P.C. (or Klondyke P.C.).—The prospecting claim is situated at the southern end of the line of reef at the end and almost at the foot of the ridge, along which the reef outcrops for more than 1,000 yards. The claim was applied for in 1897. There are two shafts on the property, but the older one is now half-filled with water. The newer shaft has been put down about 10 feet within a drive which runs 50 feet on the reef into the hill.

The vein runs a little east of north and south, and dips to the west at an angle of 45 degrees; it is from four feet six inches to five feet wide, but only the three feet six inches on the footwall are sent to the battery—the remainder being a whiter and more compact quartz. From the 60-feet level the reef has been stoped to the surface for a distance of 30 feet to the south from the shaft. It cut out at the edge of the stope right to the surface; but in the old shaft, not 10 feet distant, the shareholders say it makes again. On the same level, 45 feet to the north, the payable reef is two feet six inches wide, and is increasing in size as a white "buck" quartz cuts out.

A sample was taken from the end of the north drive, and from the surface of 80 tons at the battery. It assays :—

Gold	1 oz. 4 dwt. 20 gr. per ton.
Silver	19 dwt. 14 gr. per ton.

In 1898, 18 tons were crushed for 196 oz. 17 dwt.; in August, 1899, nine tons crushed for four ounces per ton, and a further 30 tons are said to have averaged 10 oz. per ton, while 15 tons picked to five are reported to have given 15 oz. of gold.

(*b*) Springfield No. 3 N.—Locally this is known as the Syndicate, being six men's ground. It is situated on the crest of the ridge about half-a-mile from the prospecting claim. The reef runs due north and south and dips about 30 degrees to the west. It is about five feet wide, and is made up of several parallel veins of quartz in juxtaposition, much "dogtooth" (quartz) being developed with clear crystals in the cavities, and some little mineral in parts. The vein is apparently constant for 100 yards or so along the ridge to the south, but it then tapers out (on the surface), and its course to the prospecting claim is shown by a few fragments instead of a blow of quartz. The stone is said to have yielded about one ounce per ton, though one crushing, in 1898, of 19 tons gave 36 oz. 12 dwt. of gold.

Slickensided decomposed gneissic granite and schist form the footwall, mica schists forming the hanging-wall; a dyke of diorite comes in some yards to the west, and is succeeded by schistose decomposed granite. A tunnel was driven into the western side of the ridge to tap the reef a couple of hundred feet below the top of the ridge, but on reaching it work was suspended. A good deal of trenching has been carried out on the outcrop, and a shaft has been sunk.

Springfield No. 5 N.—The reef here is similar to the exposure in No. 3 N., but no shaft has been sunk. The stone from the trenches is reported to have yielded up to 10 oz. per ton, which gives no idea of its value, as it was hand picked. In 1896, 6½ tons, packed to the Coen, were crushed for 14 oz. 13 dwt. of gold.

Springfield No. 6 N.—This claim is at the opposite end of the ridge to the prospecting claim in a similar position. Here, near the surface, the reef looks much better than in the other "numbers," very little "dogtooth" being present. The reef is four feet wide, and dips west at an angle of 45 degrees. There are two shafts here, the new one only 20 feet deep. There is a certain amount of mispickel through the vein, but most of the stone is thrown aside when the richer auriferous portions have been picked out.

A sample was taken from an open cut and from the shaft, which resulted on assay as follows :—

Gold	8 dwt. 12 gr. per ton
Silver	10 „ 9 „ „

In 1898, 6 tons were crushed for a yield of 69 oz. 17 dwt.

Colley's Old Claim.—This lies three-quarters of a mile north-west from the Springfield No. 6 N. The reef is from one to three feet wide, dips steeply to the west, and runs north and south. The country is mica schist. There is one trench only, exposing good stone, thought to run 18 dwt.; but gold is found also in the "dogtooth," which is not looked upon by miners as a good sign, nor did it prove such on the Hamilton Field.

Klondyke King.—A trench has been cut on a five-feet vein of good-looking quartz, one-half mile west of the Springfield No. 6 N., and about three furlongs from Colley's Claim—which is on a different reef. The outcrop is north and south, and the dip is 70 degrees to the west. The vein cuts out to the south. A parcel of 13 tons of picked stone has been sent to the battery for trial. A section exposed at one end of the trench shows 15 inches of white quartz on the hanging-wall, 24 inches of mineralised quartz, a few inches of "dogtooth," 12 inches of mineralised quartz, and 12 inches of white quartz (a rough-banded structure due to reopenings of the fissure).

Summary.—From the above it is seen that most of the mines on the Coen Field are in granite or in a thin bed of slate in granite, a few being in schist. The occurrence of an intrusive granite in schists is somewhat similar to that at the Hamilton.

The average value of the reef gold won in 1899 was £2 7s. 6d. per oz., but in 1895 it was £2 17s. 6d. The total annual yields as given by the Wardens are—

1894	2,291 tons crushed for	3,687½ oz.
1895	2,622 „ „	3,953 „
1896	1,854 „ „	4,020 „
1897	3,311 „ „	4,620 „
1898	2,263 „ „	5,138 „
1899	2,207 „ „	3,783 „

Besides which 66 tons are given as crushing for 336 oz. in December, 1900, the total for that year being given in the *Queensland Government Mining Journal* for February, 1901, as 2,084 oz. crude, yielding 1,139 oz. fine gold.

ALLUVIAL.

Coen alluvial was worked for six months in 1878 (as already mentioned), and even for that short time gave such poor results that it has not since been worked by Europeans. The following seem to have been the chief workings :—

Chinaman's Gully, running in a north-easterly direction from the old Wilson Mine to the Coen River, a couple of miles above the town, was the only payable portion of the field ; the whole of the alluvial has been thoroughly turned over. The gully is a small one, and the alluvial extended for only two or three hundred yards on the flats, a short distance from the river. This is true waterworn alluvial.

Yanky Bill's Gully is about a mile south-west from the Wilson, and did not yield any considerable amount of gold.

Soda and Acid Creek runs into the Coen river about half-a-mile above the town, and on it about one mile above the junction is the Wilson Mine. There are very few workings here, the gold not being sufficient to pay for tucker, the wash in addition needing to be stripped of several feet of soil.

Old Township Creek runs from the north into the Llankelly Creek, half-a-mile or so west of the present town. At various points up this creek are workings, but the wash was not payable to any extent.

Dr. Jack mentions the old workings on Two-Mile Creek and up the Llankelly.

The gullies in which the alluvial is found are not extensive, but the alluvial, owing of course to its poverty, has not been exhausted.

No alluvial is worked either at the Springs or at the Klondyke.

GEOLOGY.

The Coen shows no great diversity of rocks or minerals, although there is more variety than on the Hamilton, 20 miles or so to the south.

The Coen and Hamilton agree in being on the junction of schists and granites, though the granites are differently constituted, and those on the Coen are more massive but still altered. Beds of fissile altered sedimentary rock, in some cases fissured and quartz veined, occur on both fields, and the bed of quartzite in schist on Mount White is a duplicate of that on New Mount Ryan, at the Hamilton.

The Coen, however, is on the most eastern portion of the schists, while the Hamilton is well within the eastern limits.

The rocks are described in detail below.

Schists.—To the south-east of the southern end of the Geikie Range is a garnetiferous gneiss which extends to the river. Above the native police camp, just under Mount White, it appears exceedingly like a biotite granite, especially when in hand specimens [*See Appendix B* (1)]. Further to the east again the rock is schistose.

For some distance north and east of Mount White the schists extend—veins of quartz, some garnetiferous, being found in it there. This portion—and therefore the whole—is, without doubt, of sedimentary origin.

Mount White itself is caused by the outcrop of a large bed of quartzite, which must be of considerable extent in depth, for a spring flows from it on the summit. The rock is pink and vitreous, and is spangled with mica. [*See Appendix B* (2)]

Quartz schist occurs above the Long Tunnel, on the hilltop.

The schist extends north to the Wilson Mine, and beyond ; but on the Coen River, at the mouth of Chinaman's Gully, there is a black slate (?) and decomposed granite.

Schists are found at the Springs and Klondyke, and there are all gradations between schist and granite on the road between the two centres.

The country rock in the Abdalla Mine appears schistose, both in rock masses and under the microscope, but in hand specimens, though darker, is not unlike the eurite from the Great Northern No. 1 S. [*described in Appendix B*], except that it carries a small amount of pyrites. [*See Appendix B* (3).] It may be a crushed and altered eurite.

Slate.—As this weathers into thin slabs, and has every appearance of a slate, yet is wedged in among granites, the real nature of the rock is difficult to determine. It outcrops first within a couple of hundred yards south-east of the Great Northern. Here it runs north-north-east, and the dip of the cleavages is 30 degrees in a direction 112 degrees east of north. The belt is only a few yards wide, for within 20 yards from the schists on the west granites outcrop on the east. In hand specimens the rock appears like a very compact felsite.

The strike is constant for a short distance, but then changes to the north, and continues so down to the Llankelly Mine, where specimens brought from a depth can be obtained. These differ from the above in being white, and far less compact, and in being impregnated with pyrites. [*See Appendix B* (9).]

The outcrop then crosses the creek, and continues for a few hundred yards, when there appears to have been a fault (or a bend), for it is found a couple of hundred yards to the west. It continues in a northerly direction, through the Homeward Bound, and on to the north, where Dr. Jack saw it, and remarks, in the report mentioned, that about four miles above the town the river falls "over thick, nearly vertical beds of greywacke, whose strike is from north to south. The greywacke beds form the crown of the hill on both banks of the river, as well as the most constricted parts of the gorge. In other parts of the river bed, as well as on the hills, nothing but granite is to be seen." In parts the rock is so altered that it is impossible to distinguish it either in hand specimens or under the microscope from eurite. [*See Appendix B* (8).]

A belt must have been passed through in sinking the Daisy Shaft, for there is a good deal of it on the mullock heaps. The undecomposed rock is very similar to that at the Llankelly, and is also impregnated with pyrites. [*See Appendix B* (10).] This weathers to a brownish-speckled rock, owing to the decomposition of the pyrites. [*See Appendix B* (11).]

About three-quarters of a mile to the east of the Llankelly eurite is another outcrop, parallel to the first, and also dipping to the east. To the naked eye it looks much like a coarse-grained porphyry, dotted with small black crystals and greenish spots. When unweathered, it appears quite unlike the Daisy and Llankelly Slates. [*See Appendix B* (12).]

The country rock in the Great Northern No. 1 S. was considered in the field to be a serpentinous schist or slate. A section, from the hanging-wall rock, under the microscope much resembles those of the rocks above described. [*See Appendix B* (13).]

Decomposed and Altered Granite.—The rock on the eastern side of the "Homeward Bound" Ridge has been referred to, and the granite on the west of the Llankelly is probably the same as that. Decomposed granite occurs also at the Westralia, at Klondyke, and on the Springs-Klondyke Road, where segregation veins of quartz and felspar are common.

On the north-east of the Great Northern Line of Reef is an outcrop of biotite granite, which is an altered rock.

Besides the granites referred to there is the "Daisy Granite," which extends from the slate outcrop at the Llankelly towards the high range on the east, and is also found at the Hanging Rock. A specimen from the Daisy, not, however, unweathered, was noticed in the field to be granitic in structure, with quartz predominating, but with much comparatively soft greenish mineral—pinite. [*See Appendix B* (5).] The same rock, when in a much more weathered or altered condition, appears to be coarsely granitic, and to consist of yellowish-green pinite quartz and mica. [*See Appendix B* (6).]

Massive Granite.—This rock resists weathering to a far greater extent than the above, faces of the rock appearing quite fresh, and in weathering it shows a great tendency to form "kernels" of a general spheroidal form. These are the more compact weather-resisting portions left by denudation of the rest of the rock. The granite occurs on the western side of the "Homeward Bound" Ridge. [*See Appendix B* (4).]

Massive granite forms the McIlwraith Range, through which the Llankelly Creek breaks, and the same rock forms the range running south from Mount White, with which the above is connected.

It occurs with porphyritic orthoclase on the way to The Springs, and alternately with schists during the earlier part of the journey to Klondyke. It is seen also on the descent of Massey's Spur (McIlwraith Range) from Klondyke to the sea-board, where it is intersected by diorite and syenite (?).

The plains are also probably of this acid eruptive, judging by the sand, as there is no outcrop of rock.

Eurite.—The greenish flinty rock from the hanging-wall country in the Great Northern and Great Northern No. 1 S. proves to be eurite. [*See Appendix B* (14)].

Diorite.—A belt of this rock is seen where the Coen-Port Stewart track crosses the watershed between the Coen and Stewart Rivers. In hand specimens it looks like a fine-grained granite, but its nature is indicated by the red soil into which it weathers. It occurs on the junction of schists and granites. Microscopical examination proves it to be quartz-mica diorite. [*See Appendix B* (15).]

Several belts of diorite-like rock are passed over on the journey from the Springs to Klondyke, apparently, in places at least on the junction of schist and granite. Specimens of these for sectioning were not procured, but from their position it is just possible that they are the outcrops of a much altered rock. The section described in Appendix B (15) has many of the characteristics of such a rock, as, for instance, its granular nature, the inclusions of quartz in other minerals, and the undoubtedly secondary minerals present.

A large dyke of diorite occurs on the east of the Springfield Line at the Klondyke, and numerous outcrops occur on the way to the Bal-cony, the top of Massey's Spur, which is four miles from the camp. A fragment obtained on the Bal-cony itself has the appearance of a slightly weathered fine-grained diorite showing a certain amount of flow structure. The microscope proves it to be a hypersthene diorite. [*See Appendix B* (16).]

At the Klondyke Battery the country is schistose, but just below it is an outcrop that was taken for diorite on the field. Microscopically, however, it it much like a secondary rock such as an intensely altered hornblende schist. [*See Appendix B* (17).]

Syenite (?).—Several outcrops of a fine-grained grey rock, with large crystals of felspar, a few blebs of quartz, and jet-black grains of hornblende (?), are seen on the descent of Massey's Spur. [*See Appendix B* (18)]. The same occurs between Klondyke and Massey's Spur, often in an amygdaloidal condition.

Veinstone.—The most prominent veinstone of the whole disirict is quartz, but the Daisy makes an exception in having fluorspar and calcite with very little silica as lode material. The quartz as a rule has a blue tint—in the Great Northern Line of Reef, due to the plumbago-like mineral (probably a magnesian silicate), in the others to mispickel.

Minerals.—The only minerals worth noting occurring here are—fluorspar as a vein material; almandine garnet in schist; ilmenite in the river sands with garnet; mispickel in quartz veins; wolfram, said to occur in a nine-inch vein (as bunches in quartz and as layers with molybdenite on the sides) on eastern waters about eight miles east from Coen. The prospector affirms that the vein runs for a distance, but tapers out and splits up into leaders in sandstone on the north. The secondary minerals cyanite, sillimanite, zoisite, scapolite (probably dipyre), and pinite are interesting, but not economically important.

TIMBERING AND MACHINERY.

Sets alone are used everywhere, and would be absolutely necessary for the skid runners in inclined shafts, even if there were no pressure from the hanging-wall. Lining will have to be used below the water level, the walls there not standing at all well.

The winding appliances on the field consist of whims and whips. No tramways are in existence, though at the Westralia P.C. they have an inclined ropeway for sending ore to the foot of the hill. Crushing machinery is represented by four stamper batteries. The first, that at the Wilson, originally consisted of 15 head of stampers, but five head have been removed, and the remainder have been lying idle for years—falling to ruin. The Coen Battery consists of five head of stampers with Stanford Automatic Feeder, &c.; it lies on the bank of the river just at the junction with the Llankelly. The Springs Battery of 10 head is compactly arranged in one shed with boiler, tables,

and pans. About a mile and a-half in a westerly direction from the Klondyke Camp is a 10-head iron battery driven by an 18-feet diameter overshot water-wheel, water being brought from Station Creek, a couple of hundred yards above the site of the battery. All three mills are just now unable to work on account of the scarcity of water.

In connection with the treatment of ore, it may be mentioned that there is a three-vat cyanide plant at the Wilson Mine—erected four years ago—to treat the tailings there; and another three-vat plant is being erected near the Coen Battery.

CONCLUSIONS.

Since the field was opened in 1892 there has been plenty of time to thoroughly prospect it and to test the reefs. Some harm is claimed to have been done by the useless expenditure of so much capital on the Wilson, and much money is said to have been sunk in the Llankelly. There seems to have been, however, too great a tendency in the past to throw up a reef as soon as it pinched or the gold decreased, as in the case of the Great Northern, where (after giving 17 oz. per ton at the surface) the reef pinched, and was abandoned, but on being again taken up gave payable results.

At present matters on the field are almost at a standstill, owing, chiefly, to the opening of the Hamilton Field, but also to the drought. Only five mines are now working.

The outlook for a field with three good reefs cannot be considered promising.

Our stay on the Coen was limited to a week, because there was no grass and little water, and no horse feed could be procured on the field, though Sergeant Whiteford very kindly gave us all the assistance in his power.

With regard to the accompanying map, it may be stated that bearings were taken to connect the different features on the Coen proper, and to connect the Springs to the Coen; the Klondyke has been added to give an idea of its relative position to the other camps, but without sufficient data for it to be of any great use. The schists pass insensibly into the decomposing granite, but an approximate boundary between the two has been marked. The granites are interspersed with schists on the way to the Springs, and thence to the Klondyke there is a continual alternation of the two with occasional occurrences of diorite, but there was no time to map this portion even if it had been worth while.

APPENDICES.

APPENDIX A.

Micropetrology of the Hamilton.

1. *Sillimanite schist* (p. 2).—Chiefly indistinctly terminated and sometimes bent crystals of sillimanite stained in places by alteration into pinite; crystals usually parallel, but not infrequently radiating. Quartz is present as irregular fragments containing crystals of apatite and small grains of topaz.

2. *Biotite granitite* (p. 2).—Granular, holocrystalline, and all minerals, except one or two small crystals of orthoclase, allotriomorphic and mostly altered. A little granophyric structure is present. The constituents are as follows, in their order of abundance:—

Plagioclase (including Microcline).—Some broken and all altered to a great extent, on cleavage planes especially.
Quartz.—Both primary and secondary, and in the former are lines of bubbles and a few solid inclusions.
Biotite.—Mostly unaltered, but a few flakes are completely altered to viridite.
Orthoclase.—Chiefly granular, but there are a few small crystals, all kaolinised.
Apatite.—As needles, but scarce.

3 *Altered Sedimentary Rock* (?).—Crypto-crystalline base with irregularly shaped blebs of quartz, which fade off into the ground mass. Stains of limonite are frequent.

4. *Eurite* (p. 2).—Granular felsitic base, stained with haematite and partly spherulitic. Quartz is the only distinguishable mineral, and occurs as small grains either with corroded edges or gradually fading into the base (possibly secondary).

5. *Quartz porphyry.*—Crypto-crystalline base with scattered porphyritic crystals of pinite, sericite, and quartz, but part is spherulitic. The mineral referred to pinite occurs in twinned crystals corresponding to those of orthoclase, of which pinite is an alteration product. The sericite also shows crystal faces, but never the complete number, and always altering into brown and green non-pleochroic minerals. The originally idiomorphic quartz has been corroded into irregular granules. The quartz which is corroded carries a fair amount of very fine inclusions in addition to needles of apatite.

6. *Eurite.*—Crypto-crystalline base with large quantity of secondary minerals. The distinguishable constituents are:—

Altered scapolite (derived from felspar).—Tetragonal forms of slight brownish colour with distinct banding.
Cordierite.—Small colourless hexagonal crystals full of irregular inclusions.
Muscovite (or sericite).—Frequent rectangular flakes.
Secondary calcite.—In some quantity.
Quartz.—Allotriomorphic and in small amount.
Apatite.—Fair-sized needles.

7. *Eurite* (p. 3).—An even-felted crypto-crystalline base of felspar and quartz, with veinlets of secondary quartz.

8. *Altered sedimentary rock.*—A very fine base of interlocking grains of quartz and felspar, due most likely to alteration under high pressure and dry heat.

9. *Hypersthene diorite.*—Structure is granitic, there being scarcely any idiomorphic crystals. The constituent minerals are:—

Hornblende.—In excess, sometimes showing idiomorphic faces.
Hypersthene.—Almost as plentiful as the hornblende, with inclusions arranged parallel to the cleavage.
Plagioclase.—In much smaller grains than the above minerals, and aggregated to a certain extent.
Quartz.—A small amount, perhaps secondary.
Apatite.—In fairly large needles.
Topaz.—As granules.

10. *Quartz diorite* (p. 3).—Holo- and micro-crystalline. The following minerals are present:—

Hornblende.—In abundance, somewhat altered, idiomorphic at times, and both brown, and almost colourless.
Actinolite.—In some quantity, as radiating columnar aggregates, showing cross cracks. Slightly altered.
Sassurite.—White, almost opaque, masses representing totally altered plagioclase, the cleavage of which can just be seen in one or two places.
Quartz.—Allotriomorphic, full of bubbles.

APPENDIX B.

Micro-Petrology of the Coen.

1. *Garnet schist.*—Structure is granitic, and minerals are allotriomorphic and granular owing to their secondary origin. The constituents are:—

Plagioclase.—Somewhat schillerised in parts, and also cracked. It includes grains of quartz (perhaps of the original rock) and crystals of topaz.
Quartz.—As grains, and also as secondary veins.
Biotite.—Unaltered, and plumose.
Hornblende.—Just a few grains in the section.
Orthoclase.—Slightly kaolinised.
Apatite.—In both quartz and mica.
Topaz.—Fairly large grains in the quartz and felspar.

2. *Quartzite* (p. 24).—Quartz grains scarcely distinguishable, but partly cemented by secondary silica; viridite as a staining matter in small quantity; secondary muscovite; stains of hæmatite; and grains of zircon of fairly large size.

3. *Schistose rock* (p. 24).—Numerous lenticular aggregations of crushed or secondary quartz, separated from one another by bands of a green non-pleochroic material.

4. *Massive granite.*—A porphyritic specimen from near the Hanging Rock—granitic, and containing the following:—

Microcline.—Schillerised, some sections showing large plates of secondary minerals (scapolite (?) and quartz).
Orthoclase.—Kaolinised twins, sometimes showing parallel and radiating cracks, due to the formation of secondary minerals.
Quartz.—Both as allotriomorphic crystals and as rounded grains included in the felspar.
Scapolite.—
Biotite.—
Muscovite.—Some altered, even though itself secondary.
Apatite.—Included needles in quartz.

This may be an altered rock.

5. *Altered granite* (p. 25).—Almost all the minerals are allotriomorphic:—

Microcline.—Both schillerised and kaolinised.
Quartz.—Full of solid inclusions, sometimes arranged on lines of crystal faces.
Biotite.—Fairly plentiful and unaltered.
Plagioclase.—Scarce.
Scapolite.—Small grains in microline, and due to the alteration of that mineral. Six-sided sections.
Secondary minerals (muscovite, &c.)—plentiful.
Pinite.—Appearing as a grey-clouded mineral, and happening to be less plentiful in the section examined than elsewhere in the rock.
Zircon.—The usual stumpy prisms.

6. *Altered granite* (p. 25).—Granitic and allotriomorphic, the minerals being:—

Quartz.—In large excess, corroded at times. Traversed by innumerable tiny cracks and lines of minute vesicles.
Pinite.—Opaque and allotriomorphic; seemingly it has attacked the quartz in places.
Felspar.—Almost completely altered into scapolite in the first place and then into pinite.
Apatite.—Needles of some size in quartz, one unusually perfect crystal being visible.
Muscovite.—Scarce.

7. *Altered granite* (junction of above with biotite rock at Hanging Rock).—Granitic and consisting of:—

Quartz.—Abundant, allotriomorphic and idiomorphic, and full of inclusions. A little of it is secondary on the junction with the biotite.
Microcline.—Very abundant, somewhat schillerised and sometimes greatly crushed and altered.
Scapolite.—Due to the decomposition of a felspar, both opaque and clear; short crystal laths with clear borders.
Biottie.—Belonging to the rock over the junction; bent flakes.
Apatite.—Abundant as perfect crystals in the quartz.
Sillimanite.—A plumose bunch on the junction.

8. *Slate.*—Uniform crypto-crystalline base, in which are very few secondary minerals, but clouds of minute cubical crystals of limonite after pyrites. Veins of secondary quartz traverse the section, and "eyes" of it occur in the crushed parts where the one or two grains of other secondary minerals are to be seen also.

9. *Slate* (p. 24).—A great development of sillimanite, but otherwise is similar to the sections of rock from the Daisy. Quartz is scarce, however, and calcite is absent. Some of the pyrite crystals have small foreign crystal laths or plates at their centres. The pyrites are well crystallised and show out well in the crypto-crystalline base.

10. *Slate* (p. 21).—From the Daisy Mine. Crypto-crystalline (almost micro-crystalline) none of the crystals except the secondary calcite and pyrites being sharply marked off from the ground mass. It is more perfectly crystalline, however, than that described below as coming from the Great Northern No. 1 South. Following are the constituent minerals :—

Quartz.—Small grains disseminated.
Orthoclase.—Very small, but perfect untwinned crystals.
Sillimanite.—Indefinite tapering laths with one square end. Greenish hexagonal sections with magnetite inclusions.
Calcite.—A secondary filling in cracks.
Pyrites.

11. *Slates* (p. 24).—Crypto-crystalline and similar to above, except that all the pyrites have been altered by oxidation into limonite, and there are some well crystallised hexagonal laths of cyanite, showing a central twinning plane. Besides, there is some secondary quartz and a few corroded grains with a couple of crystals of chiastolite (?). These secondary minerals, though characteristic of altered sedimentary rocks, also occur as alteration products of some of the constituents of eruptives.

12. *Altered sedimentary rock* (p. 25).—Crypto-crystalline base with scattered hexagonal cross sections of zoisite, chiefly changed to a green viridite in which are strings of some brown mineral running at right angles to the edges. Filaments of sillimanite are also visible. Leucoxene occurs as small crystals and grains (after ilmenite). There are also much altered crystals of felspar (into scapolite or pinite), which are scarcely distinguishable from the base.

13. *Slate* (?) (p. 25).—Clear and colourless with streaks and dots of greenish matter. The base is felsitic and crypto-crystalline, with a great deal of quartz (perhaps, secondary), and throughout it are thickly scattered in distinct crystals or grains of felspar and quartz, with laths of cyanite at intervals and much altered crystals of sillimanite. It is traversed by cracks, filled with secondary quartz, in which are spherulites of the ground mass. The sillimanite laths are bordered by lines of magnetite, and are changing into a green pleochroic mineral.

14. *Eurite.*—Fine-grained green flinty felsite with veins of milky quartz occurring beside the reef in the Great Northern No. 1 S. Fine felsitic base with many quartz veinlets and fine grains of pyrites. The base probably consists of crypto-crystalline quartz and felspar.

15. *Quartz-mica diorite* (p. 25).—Granitic structure. Constituents :—

Plagioclase.—As short grains rather than crystals, somewhat schillerised, and much kaolinised sometimes.
Hornblende.—Carrying quartz inclusions.
Quartz.—Both primary and secondary.
Biotite.—Bent crystals.
Viridite.—Derived from mica and hornblende, with inclusions of quartz.
Magnetite.

16. *Hypersthene diorite* (p. 25).—Micro-granitic, with no idiomorphs, except apatite. Constituents in order are :—

Monoclinic pyroxene—granular aggregates, representing shattered crystals, whose form is sometimes still indistinctly retained. This is a very pale variety—possibly malacolite.
Hypersthene.—In great abundance in conjunction with the augite, as roughly oriented lenticular masses.
Plagioclase.—Granular and comparatively inconspicuous.
Quartz.—Almost as plentiful as the plagioclase, but much of it is certainly secondary.
Magnetite.—Fairly large irregularly-shaped grains.
Apatite.—In great abundance, as inclusions of unusually large size.

17. *Hornblende rock* (p. 25).—Holo-crystalline in structure, the minerals being allotriomorphic. All the hornblende crystals are in contact with at least one other of the same mineral. Besides the hornblende, which is quite fresh, there are granules and secondary deposits of quartz, large grains and strings of magnetite, very few granules of plagioclase, and some little secondary mineral in addition.

18. *Syenite* (?) (p. 25).—Meshed felspar occupies almost the whole of the section, the interspaces being followed with viridite, the result of the complete decomposition of the ferro-magnesian mineral. The felspar when not kaolinised is seen to be twinned sanidine. Magnetite occurs in very small grains. Secondary calcite fills cavities, and in one place its centre is occupied by an irregular grain of primary quartz.

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GEOLOGICAL SKETCH MAP

To
accompany Report
on the

COEN GOLDFIELD

BY

LIONEL C. BALL B.E.

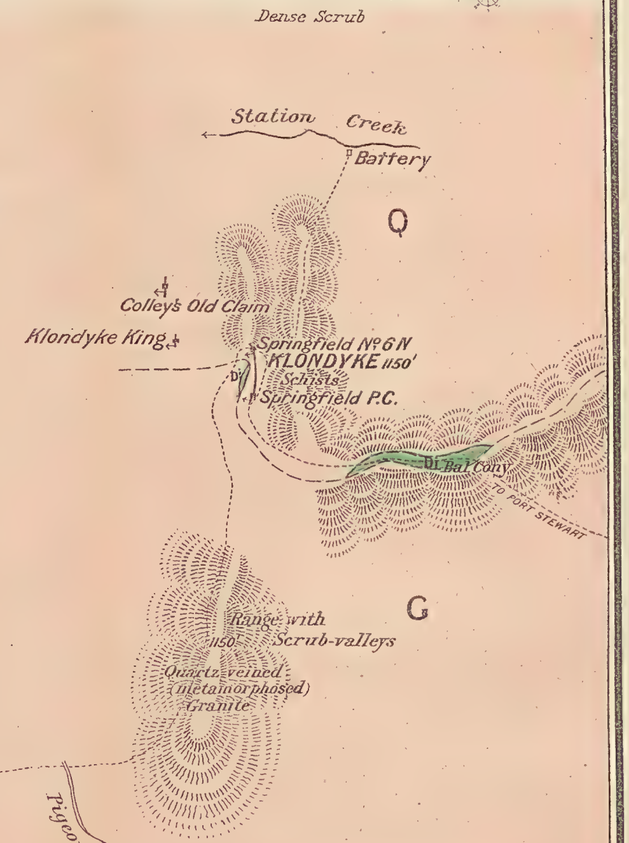
Assistant Government Geologist

1901

Scale 1 Mile to an Inch

1 3/4 1/2 1/4 0 1 2

DRAWN BY H.W.FOX AT THE GEOLOGICAL SURVEY OFFICE, BRISBANE 1901.



REFERENCE

- Q — Schists Quartzites &c.
- G — Granites
- Di — Diorite

By Authority: EDMUND GREGORY, Government Printer, William street, Brisbane.

GEOLOGICAL SKETCH MAP

To

accompany Report

on the

HAMILTON GOLDFIELD

BY

LIONEL C. BALL B.E.

Assistant Government Geologist

1901

Scale 40 Chains to an Inch

40 30 20 10 0 40 80 120 160

Drawn by H.W.Fox at the Geological Survey Office Brisbane 1901.

By Authority: Edmund Gregory, Government Printer, William street, Brisbane.

REFERENCE

- C — Biotite Granite (newer)
- C — Metamorphic Granite (older)
- Alluvial Workings
- Q — Schists

Quartz Reefs

30° Schists

Granite Sand ridges

Kendall Creek

MT. LEE BRYCE

Contorted Mica Schist (veined) striking North & South

Metamorphosed Granite

Red Schist

Augen Gneiss

SCHIST MT.

Quartz veins

Ironstone

Contorted Slates

Sandy ridges (Granitic) alternating with Schist

Biotite Granite

Broken country

Mica Schist flat bedded

Quartz veins

Porphyry Dyke

Porphyry Dyke

Line of Section

Quartz Reefs striking N.W.

Abundant Qtz. Reefs

Schist striking N&S.

Metamorphosed Muscovite Granite Ryan's Claim

Garnet Schists

Schists

Schists with Quartz veins

Sandy ridge

Waterhole

Quartz Schists

Sillimanite Schist

Graphitic Quartzite

HOSPITAL HILL

Caledonia No5

" No4

Democrat P.C.

Schist

Decomposed Granite

Metamorphosed Granite

Caledonia No3 N.

Sandy ridge

Cal. No2 N.

Cal. No1 & 2 S.

Cal. No5 S.

Luck & Fortune P.C.

Metamorphosed Granite

Kruger P.C.

LOOKING GLASS HILL

Micaceous Schists

Hidden Treasure P.C.

" I.S.

All Nations P.C.

No1 N.

No1 S.

Metamorphosed Granite

Hamilton King P.C.

Oom Paul

Golden Treasure P.C.

Golden Treasure No1 N.

Broad Arrow P.C.

Brilliant No1 S.

Quartzite

Agnes P.C.

St Albans P.C.

May Queen No1 N

No1 S.

No2 S.

No3 S.

No4 S.

No5 S.

Metamorphosed Muscovite Granite

P.C. (unnamed)

Hit or Miss No1 N. P.C.

Sandy Ridges

Ross' Well

Sandy Ridges

Metamorphosed Muscovite Granite

Golden Gully

Tasmania

Quartz blow

Good Luck

Sandy Ridge

Two Mile

Coarse Schistose Muscovite Granite

Metamorphosed Granite

Last Hit

Sandy Ridge

Queenslander

True Blue

Steels Gully

Garnet Schist Sillimanite Contorted Schists

Ridges running North & South with parallel Quartz veins

Battery

Metamorphosed Granite

Quartz veins present.

Quartz veins absent

Mica Schist

Schist

Quartz veins present

Johannesburg

Four Mile

Ross' Store

Trafalgar P.C. No1 S. No2 S.

Quartz veined Schist

Quartz Diorite

Granite Camp

Ryan's Creek

Gneissic Biotite Granite

Biotite Granite

Quartz Reefs

Reef

Croydon King

Metamorphosed Granite

To Laura

MT RYAN (OLD)

Quartz Reefs

Cold Mount No2 N.

No1 N.

" P.C.

" No1 S.

Assumed junction of Schists & older Granite

Lukin River

630' Ten Mile

Schists

Quartzite

Schists

MT RYAN (NEW)

Granite

Star of Hope Reef & Porphyry Dyke

Gneiss

Porphyritic Granite

Biotite Granite

Star of Hope P.C.

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1901.

QUEENSLAND.

THE CARDIGAN, QUEENSLAND, TIN SYNDICATE'S PROPERTIES, THOMPSON'S CREEK, AND THE COOLGARRA FEDERAL TIN CORPORATION, LIMITED, LEASES, HERBERTON MINERAL DISTRICT, NORTH QUEENSLAND.

(REPORT ON, BY WALTER E. CAMERON, B.A., ASSISTANT GOVERNMENT GEOLOGIST.)

Presented to both Houses of Parliament by Command.

LETTER OF TRANSMITTAL.

TO THE HONOURABLE THE SECRETARY FOR MINES.

Geological Survey Office,
Brisbane, 8th July, 1901.

Sir,—I have the honour to forward herewith Mr. Walter E. Cameron's Reports on the Cardigan, Queensland, Tin Syndicate's Properties, Thompson's Creek, and the Coolgarra Federal Tin Corporation, Limited, Herberton Mineral District, North Queensland.

I have, &c.,
WILLIAM H. RANDS,
Government Geologist.

THE CARDIGAN, QUEENSLAND, TIN SYNDICATE'S PROPERTIES.

The above syndicate has acquired a number of abandoned tin properties formerly worked for tin by the prospectors of the Herberton Field. These properties are now held as Leases Nos. 1433, 1437, 1571, 1721, 1722, 1734. The object of the Syndicate is to develop and work them in a more systematic manner than was possible with the methods available to small parties of working miners. The chief incentive to commence this work has been no doubt the increased prices for tin ruling of late years, and in some measure probably the increased accessibility of the mine, brought about by the nearer approach of railway communication with the coast, owing to the extension of the Cairns to Mareeba Railway line by the Chillagoe Railway and Mines Company.

The properties lie on the summit of the main divide between the gulf and east coast waters, at the heads of Thompson's Creek flowing to the west into the Walsh River, and of Mowbray Creek flowing to the east into the Wild River. The syndicate's offices are about 8 miles due south of Irvinebank, and about a mile or so off the main road between that town and Coolgarra. The leases are all situated within a radius of 2 miles from a central point.

The evidence of former mining and the occurrence of good tin-bearing stone are seen in the shape of numerous shallow shafts and surface workings, and in the occurrence of ore scattered in small heaps over the surface near the workings. These heaps represent the stone culled and cast aside by former parties as too poor to pay for cartage to batteries at the lower price of tin of former times. The workings, except where they have been put in order by the present syndicate, are all in a more or less ruined condition, and therefore often afford little definite information as to the mode of occurrence or value of the lodes. The conclusion that good tin ore still remains to be extracted is inferred more from the mode of occurrence of the ore bodies exposed in the later workings of the present syndicate, together with the fact that the lodes have paid former parties of working miners under much less favourable conditions than those at present existing.

The country rock on which the six southern leases lie is a porphyry or eurite, composed of blebs of pink orthoclase and quartz in a fine-grained matrix of quartz and felspar. In places the matrix is so small in quantity, as to be unrecognised with the naked eye, and the rock approaches to a fine-grained aplite in its mineralogical characteristics. Further north, as the waters of the Thompson on the Gulf Fall are descended, the boundary between the porphyry, and the metamorphic rocks into which it has been intruded, is crossed over, and can be followed in a fairly well-defined line. The Fanny Parnell Lease, the northernmost of the group, lies in this country.

The district was reported on in 1883 by Dr. Jack, then Government Geologist.* He thus alludes to the manner of occurrence of the tin in the Herberton district generally:—

"One fact unnoticed and unsuspected when I wrote my first report comes out clearly and unmistakably from a detailed examination of the field now that something more than the mere surface is accessible to observation. The fact is: the intimate connection of the tin deposits with metamorphosed igneous dykes. The basic rocks of the dykes seem to have undergone a gradual process of metamorphism. The dykes now consist mainly of quartzose chlorite, and occasionally of quartzose serpentine. It may be inferred that they were originally consolidated as quartz diorites, or as rocks more or less of the basaltic type. The tin ore occurs in floors, veins, or pipes, among the joint planes of the dykes."

In all the lodes of the group under consideration, where good exposures were observable, the main feature is a well-defined dyke of decomposed igneous material as described by Dr. Jack. These dykes are traversed by veins of quartz, running generally with the trend of the dykes, but branching off and anastomosing with each other, and carrying the main body of the tin in veins and streaks through them. A large proportion of the tin is, however, often found impregnating the dyke material itself in the neighbourhood of the quartz veins. Dr. Jack says: "As the dykes have originated in a deep-seated mass of molten matter, they may be expected to carry the tin ore to greater depths than are ever likely to be reached by mining." There is no doubt that Dr. Jack's remarks are perfectly applicable to the group of lodes being developed by the Cardigan (Queensland) Tin Syndicate. Every confidence can then, I am of opinion, be placed in the prospects of the permanency of the lodes in depth. The question as to whether the results, already obtained by the present syndicate, warrant a continuation of prospecting and development work may best be judged from the facts concerning the lodes, ascertainable during my visit, which are given below:—

The Alexandra Lode.—The syndicate has opened up three old shafts on this lease. No 1 shaft, the most northern of the three, is 63 feet in depth, on a vertical lode striking north and south. The shaft shows stoping down the ends, which has not apparently been carried any considerable distance in. About half-way down on the southern end an inclined winze can be followed in a few feet and shows overhead a good vein of quartz, carrying tin. At the bottom of the shaft the beginning of a drive to the south shows a diorite lode enclosed in porphyry. The lode is about 1 foot in thickness and carries good tin in veins of quartz running through it, and also in the lode material itself. There are here no distinct walls to the lode, but it shades off more or less gradually into the porphyry into which it has apparently been intruded. Mr. Butefisch, the manager for the syndicate, informs me that a parcel of picked ore from the last few feet in this shaft, weighing 7 cwt. 1 qr. 22 lb., was sent to the Irvinebank Smelting Works for sale. The works returned me a value of 15·7 per cent. metallic tin for the parcel, which gives a value for the parcel of £6 11s. 8d. with tin at 21s. per unit.

About 200 feet north of the No. 1 shaft are the remains of another old shaft on the same line of reef, but it is in ruins. Judging by the mullock heaps a considerable amount of work was done at it. The outcrop between the two shafts has been exposed by various potholes.

No. 2 shaft lies about 420 feet south of the No. 1 shaft. It was sunk on a lode underlying steeply to the N.N.E., and a level was driven at a depth of 90 feet along the lode to the E.S.E. for a distance of 82 feet. The lode is seen as thin seams of quartz in porphyry in the roof of this drive. The present syndicate has driven 16½ feet further along the lode, which here bends slightly to the east. The present face shows about 2 feet 6 inches of quartz, carrying a little tin. According to the manager a parcel of picked ore of 21 cwt. 1 qr. 13 lb. was obtained from this 16½ feet of driving, and sent to the Irvinebank Works for sale. The Irvinebank Works gave me a return of 5·6 per cent. metallic tin as the assay value, giving a value for the parcel of £5 19s. 7d. with tin at 21s. per unit.

About 90 feet further to the W.N.W. the lode has been worked out from the surface in a pit some 20 feet long and 6 feet deep in which water was standing.

About 420 feet E.S.E. from the No. 2 shaft, and apparently on the same line of lode is No. 3 shaft. It was inaccessible. Mr. Butefisch tells me it was 26 feet deep. The outcrop of the lode has been worked out from the surface for a distance of about 60 feet in a direction south 40 degrees east from this shaft, but the workings have fallen in, and water was lying at the bottom.

The Vesuvius Lease lies about half-a-mile north-west of the Alexandra. Near the north end a shaft 61 feet deep has been sunk on a highly-inclined lode. The lode was thus described by Dr. Jack:—†

"Vesuvius.—This claim lies north-east of the Pompeii. A shaft 45 feet deep has been sunk on a quartz reef running N.N.W. to S.S.E., and underlying at 70 degrees to W.S.W. The reef is partly discoloured with iron peroxide, and has a brecciated gangue underlying it. It underlies a great diorite dyke. About 20 tons of stone have been raised from the shaft.

The ore is never in compact masses, but is fairly well scattered through the quartz and diorite, say to the extent of 15 per cent. of the whole. The dyke is distinctly traceable into the adjoining claim, the No. 1 Vesuvius.

No. 1 Vesuvius.—A 50-feet vertical shaft has been sunk on the dyke. A floor of tin ore is seen in the bottom. A quartz reef at least 2 feet wide is seen on the surface near the reef.

About 15 tons of stone have been raised—a mixture of quartz, diorite, and buff-coloured tin ore. The latter amounts to about 15 per cent."

There is nothing in Dr. Jack's report to show what were the relative positions of these two shafts, nor the distance between them. The remains of two shafts at a distance of about 5½ chains from each other, and bearing almost north and south from each other, are extant, the northernmost having been opened up by the present syndicate, and sunk to a depth of 61 feet. At the bottom, the beginning of a drive to the north shows a face of quartz in a diorite lode, the quartz being about 3 feet in width. A parcel of picked ore from this shaft of about 13 cwt., sent to the Irvinebank Works, gave an assay return of 10·35 per cent. metallic tin, giving a value for the parcel of £7 4s. 7d. with tin at 21s. per unit. The lode can be traced to the south as a prominent outcrop to the second shaft, now in ruins and full of water.

The Pillar Lease lies about a quarter of a mile south of the Vesuvius. A shaft about 40 feet in depth has been sunk a few feet up the hillside from a rocky watercourse. The lode strikes north and south, and the shaft has followed down a well-defined footwall dipping steeply to the west. At the bottom of the shaft a few inches of quartz are seen on the footwall, carrying good tin. The rest of the

* The Tin Mines of Herberton, Western, and Thompson's Creek Districts, &c.—R. J. L. Brisbane: By Authority, 1893.
† *Loc. cit.*

shaft is in diorite lode material with tin here and there through it. Mr. Butefisch tells me that further up the shaft the quartz of the lode was as much as 15 inches in thickness. He has sent 3 tons 11 cwt. 23 lb. to Irvinebank Smelting Works taken from this shaft, the assay of which given me by the works was 23·5 per cent. of metallic tin, giving a value of £92 1s. for the parcel with tin at 21s. per unit.

The outcrop of the lode has been taken out for a distance of 120 feet up the hill to the south of the shaft. The workings show regular well-defined walls about 3 feet apart.

About 200 yards further up the hill is another old shaft bearing south 5 degrees east from the former. It was inaccessible. Mr. Butefisch informs me that it is 38 feet in depth. The mullock heap and a small heap of culled stone at the surface show numerous lumps of quartz, carrying good tin.

It will be seen from the above details of the work done by the present syndicate that no very large ore bodies have as yet been disclosed by their operations. The return of ore of an ascertained value of £92 from 40 feet of sinking in the pillar shaft is, however, decidedly satisfactory. The work done has not been sufficient to test the length or depth of the shoot. The further sinking of the shaft to a depth of 50 feet, or, if still in good ore, to 60 feet, and driving to the south along the lode from that depth under the old surface workings of the prospectors would no doubt accomplish this. It shows every prospect that it would give a considerable area of backs to be stopped up on good ore. In the Vesuvius Shaft also, the prospects are hopeful, and a few feet of driving north and south would show the extent of the shoot of ore, after which the shaft could be further sunk for future development.

In the Alexandra Lease the results are not as promising, but the No. 1 shaft should be driven to the south, with the object of ascertaining the value of the lode under the old workings and the length of the shoot. In the No. 2 shaft the lode is of fair size, and a continuation of the present drive for a few feet is desirable with the hope of the lode improving in tin contents in that direction.

In the remaining leases little has as yet been done, the syndicate having employed its energeis in opening up the more accessible of the lodes. Dr. Jack thus describes the work done on the Tasmanina and Pompeii lodes at the time of his visit :—*

"*Tasmanian.*—This mine is on a dyke of quartzose diorite, which is clearly traceable on the surface for the whole length of the company's ground (36 chains), with an average width of about 7 feet and an underlie to the west of about 70 degrees. In the dyke, generally in the centre, lies a mass of drusy quartz, in which tin ore can be seen for considerable distances where the surface has been bared in prospecting operations. The dyke runs north and south.

The main shaft (No. 1) is 48 feet deep, and in the sinking about 1 ton of tin-bearing stone has been obtained. I estimate the total amount hitherto obtained from the shaft and open-cast workings roughly at 110 tons, containing about 40 per cent. of "black ore" together with 160 tons of rubble, which I can well believe gives (as I am informed) 21 lb. of "black ore" to the dish.

No. 3 shaft is near the southern end of the claim, near a point where the main dyke splits up into four branches. It is sunk on one of the branches running south 10 degrees west. It is only 8 feet deep as yet. It began on a mere spot of ore, which gradually widened out. At the present bottom the ore is 2 feet wide. About 4 tons of fair stone have been raised.

No. 4 working is in the south-east corner of the claim, and is just being opened. It is on a thin vein of quartz in a dyke running north 15 degrees west. This is followed for a short distance up the hill (south), in which direction it is becoming wider, and carries ore an inch or two in width.

About 50 yards south of the claim the branching dykes are cut off by a wide east and west elvan dyke. The diorite dykes can be picked up again on the other side of the elvan, and are again interrupted by several elvans. Tin ore is visible in the diorite dykes south of the large elvan. The regularity of the Tasmanian dyke is without a parallel on the field. The dyke is of a manageable width.

A capacious dam is in course of erection, and crushing machinery is on the way up from Port Douglas. (20th March, 1883. The machine is now at work.)

The Pompeii lies on the eastern or right bank of Thompson's Creek, opposite the Tasmanian machine. The country is porphyry, and is traversed by a north-west and south-east dyke of quartz diorite. It is 3 feet wide, and very distinctly traceable throughout the ground, widening to about 6 feet towards the south-east end. It is penetrated by quartz veins, especially in the middle. It also contains "floors" of tin ore. Towards the south-east end the dyke becomes locally altered to green chlorite with red discolourations, and is in parts heavy with tin ore.

A shaft 20 feet deep has been sunk. Ten tons of surface stone are ready for crushing; it consists of quartz and felspar, with about 35 per cent. of tin ore. There are about 110 tons of rubble pretty similar in quality.

A strong north-north-east dyke connects the Pompeii with the Vesuvius. It is crossed by vertical veins and threads of quartz."

The workings on the Tasmanian described by Dr. Jack are at present in ruins, the woodwork of the shafts having tumbled in, and thus rendered them inaccessible. Judging from the mullock heaps, a considerable amount of work was done at the main shaft subsequent to his visit, and several heaps of good tin-bearing stone, the remains of culled stone, are scattered about on the surface. On the Pompeii, Mr. Butefisch tells me, the shaft was put down to 75 feet, and a second shaft, 30 feet further to the south-east, is down 24 feet, and is connected with the first by a drive. Both were inaccessible.

The Cardigan Lease was described as the Colossus by Dr. Jack thus :—*

"The Colossus is a quarry opened in a huge reef of quartz, which almost entirely replaces a dyke of quartz diorite. The latter is sometimes altered to viridite. The dyke is 4 to 17 feet wide. It runs north 15 degrees west, with a slight dip to west 15 degrees south. Tin occurs in the quartz in streaks with a ribboned structure, and is freely seen in the face and bottom of the open workings. It can be traced, moreover, for a considerable distance along the outcrop of the reef, where no work has yet been done."

No development work of any consequence has been done since Dr. Jack's visit.

On Giblet's Lode is a strong "quartz diorite" dyke striking about north 35 degrees west. The old workings extend for a distance of about 2 chains along the lode, but the lode can be traced for some distance both to the north and south. To the south the workings consist of open-cast work down to a depth of 12 or 14 feet, and of a width varying from 3 to 10 feet, extending for a length along the lode of about a chain. About the centre is the remains of a shaft. About a chain further north of this work are the remains of a second ruined shaft. The syndicate has as yet done no work on this lode.

---

* *Loc. cit.*

The Fanny Parnell Lease lies about 2 miles from the Alexandra, on the Thompson's Creek Fall. The lode is in schist country, and crops out on the brow of a steep bank to a rocky creek. The lode strikes about north-east. A tunnel driven in from the bottom of the bank apparently meets a shaft on the outcrop of the lode about 50 feet up, but both were inaccessible. The outcrop of the lode can be traced for about 2 chains along the surface to the north-east, and shows good tin in places.

The re-opening of lodes which have been so ruined on the surface as those described above must always be a matter of difficulty and expense, and, on account of the impossibility of obtaining any reliable information as to the value of ore already mined, must be always very much of a speculation. From what little I could see, however, I certainly think these lodes warrant the expenditure of a moderate amount of capital judiciously laid out in opening them up again.

THE COOLGARRA FEDERAL TIN CORPORATION, LIMITED, LEASES.

The Coolgarra Federal Tin Corporation has acquired an area of about 100 acres on Return Creek, a tributary of the Wild River. The property lies about 6 miles from Coolgarra, on the Coolgarra to Mount Garnet road. The ground is held under Leases Nos. 1697, 1698, 1730, 1716, 1708, 1695, 1715.

The country rock along this road and on the leases occupied by the company is a series of considerably folded and altered sedimentary beds. As exposed in the company's workings, and in the bed of the creek, they consist principally of slates, schists, and altered sandstones, striking roughly north and south, and dipping steeply to the east. The Company has started exploration work by sinking two shafts—the northernmost situated near the eastern corner of Lease 1695, and the second about 6 chains further to the S.S.E. near the centre of Lease 1730.

The northernmost shaft is 103 feet in depth, on a steep underlie to the east. It followed tin ore down to 75 feet. At 56 feet this ore was driven on to the north for a distance of 26 feet, when it became unpayable. It was then stoped up above the drive for a height of 20 feet.

There are no defined walls to the ore-bearing stone as seen in these workings. The tin is fine in grain and is disseminated, in association with quartz, throughout a ferruginous fine-grained sandstone, which has apparently been silicified and rendered tin-bearing along certain lines, by percolation from below, by silica and tin-bearing solutions. I broke samples from the ends of the shaft, the floor of the drive, and the roof of the stopes, and had them crushed and vanned. They all gave good prospects of tin. About 150 tons of ore from the shaft and stopes were at grass, samples of which, taken at random, gave good prospects of tin. Mr. J. A. Hamilton, the Manager for the Company, informs me that 16 tons 2 cwt. of picked ore from this heap gave, at the Irvinebank Smelting Works, a return of 22½ per cent. tin while another parcel of 6 tons gave a return of 10 per cent. tin.

At a depth of 75 feet the shaft passes out of the ore shoot, which apparently dips to the north. The shaft continues down on the underlie through a soft ferruginous and talcose sandstone to 103 feet, and a level at this depth has been driven north, through the same material, for a distance of 43 feet. At 18 feet in, a crosscut has been started, and was in 6 feet without finding ore. At the end of the level another crosscut west met ore carrying a little tin at 3 feet in, and this has been driven on for 11 feet to the north. The non-appearance of the ore shoot in the bottom level raises the question whether it has passed to the east or west of the level, and the finding of ore in the crosscut west, at the end of the level, raises a hope that it has passed to the west.

The results obtained in this shaft are decidedly satisfactory. The first thing to be done is to prove the continuation of the ore body to the bottom level, and this the manager is endeavouring to do by driving on the ore body already found there. I should also recommend the proving of the extension, of the lode to the north and south, by a series of cross trenches at short intervals along the line, with the object of picking up other shoots of ore on the same line. The outcrops of the ore bodies are apparently not well marked, and might otherwise easily be missed. A systematic valuing of the ore raised is also to be recommended where it is often impossible to distinguish payable from worthless stone. By this means the ore heap can be kept up to a certain payable percentage, by discarding ore of too low grade.

The southern shaft does not at present show such good prospects as the northern. It is 60 feet deep on the underlie, and is in lode material all the way. The shaft follows a well-defined hanging-wall, dipping to the east at an angle of about 60 degrees from the horizontal. The ends of the shaft show highly ferruginous and siliceous lode material. I took samples from the bottom of the shaft, the ends, and the footwall, but they showed no prospects of tin on crushing and vanning. The ore heap also does not look promising, though a little tin is seen in some of the stone. I should recommend here, also, trenching along the surface north and south of the shaft, along the line of the lode, in the hope of picking up a payable shoot of ore.

The ore bodies exposed in the above workings do not show any of the features of true fissure lodes. They are no doubt impregnations of more or less pervious sedimentary beds along certain lines. They resemble in character some of the occurrences at Eureka Creek, now being developed by the Stannary Hills Mines and Tramway Company, notably those on the Black Rock and Black Rock Extended Leases. These occurrences were reported on by the writer October, 1899, and by Mr. J. M. McLaren, B.Sc., late Assistant Government Geologist, November, 1900. I should recommend a more systematic exploration on the surface by means of trenches and open cuts wherever tin ore can be found, in order that a better idea of the horizontal extent of the ore bodies may be arrived at. The greater portion of the ore seems likely to be of too low grade to pay for cartage to distant works, and it will consequently be necessary to prove the existence of considerable bodies of it before undertaking the erection of machinery to treat it on the spot.

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VICTORIA.

1901.

QUEENSLAND.

FOURTH REPORT ON THE GYMPIE GOLD FIELD, HAVING SPECIAL REFERENCE TO THE INGLEWOOD DYKE AND THE EASTERN LEASES.

BY WILLIAM H. RANDS, A.R.S.M., F.G.S., GOVERNMENT GEOLOGIST.

[*With Map.*]

Presented to both Houses of Parliament by Command.

THE HONOURABLE THE MINISTER FOR MINES, BRISBANE.

Geological Survey Office,
Brisbane, 24th September, 1901.

SIR,—I have the honour to forward my Report on the Gympie Gold Field, having special reference to the Inglewood Dyke and the Eastern Leases.

I have, &c.,
WILLIAM H. RANDS,
Government Geologist.

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FORMER REPORTS.

I have already furnished three reports on the Gympie Gold Field. The first of these was published in 1899, with three Geological Maps, and Plates and Sections. This report contained a detailed description of the Geology and Palæontology of the field, a full description of the Mines then at work, and the returns from the different mines to date.

The Second Report was published in 1891, and dealt exclusively with the developments that had taken place in a few of the mines since my first visit, and also with the work of the diamond drill.

The Third Report, which was published in 1895, dealt with certain geological features, the dredging of the Mary River for gold, and a description of the most easterly mines being worked at that time. It contained also petrological notes on some of the more important Gympie Rocks.

In the year 1899 I published a new edition of the Geological Map of Gympie on a scale of 4 chains to an inch, brought up to date, and showing the chief underground workings.

The object of my last visit to Gympie was to work out, if possible, the difficult problem which has arisen at the south-eastern end of the field as to the effect the Inglewood Dyke has had on the reefs and the auriferous belt of country; and also to inspect the recent prospecting work that has been carried on in the eastern ground; and these subjects are dealt with in this report.

THE INGLEWOOD DYKE.

The auriferous beds—and by that term I mean those beds in which the reefs have been proved to carry payable gold—have been traced right away from the Two Mile, at the extreme northern end of the field, to the Monkland, where they come in contact with the Inglewood Dyke; but beyond that point to the south and west, they have never been seen, although a large amount of work has been done. The country has been much disturbed by numerous faults running in a more or less east and west direction. Two of these are of very large dimensions; one between the Two Mile and Gympie Proper throws the beds down to the north nearly 1,200 feet, and throws the outcrop of the rocks on the Gympie side nearly three-quarters of a mile to the east; the other at the One Mile, known as the "Phœnix Fault or Cross-course," throws the country down to the north about 530 feet, and the outcrops of the rocks on the south side of it are no less than 530 yards to the east.

Notwithstanding these big dislocations, the principal beds of country rock have been clearly traced for the distance above mentioned.

The reefs, which run nearly parallel with the strike of the country, but which underlie at right angles to the dip of the country, have also been traced for long distances, although it has not been possible to identify, with certainty, the reefs on one side of each of the two large faults with those on the other.

On coming in contact with the Inglewood Dyke the reefs also are completely cut off, and nothing resembling them occurs on the other side.

The Inglewood Dyke has been traced from the river at a point north-west of the Inglewood Hill, near the Normanby Bridge, in an east-south-easterly direction through the old Inglewood Lease, the Great Monkland, the Nicholl's Lease, the South Glanmire and Monkland, the No. 2 Great Eastern, the No. 2 South Great Eastern (western workings), and quite lately in the eastern workings of the No. 2 South Great Eastern, and in the Scottish Gympie Gold Mines, in both of which it has completely cut off the country and the big reefs.

The Inglewood Reef has been worked for gold in all the above leases with the exception of the Scottish Gympie. It consists generally of a mullocky "formation," with quartz in it, and with a dyke of diorite, from 24 to 30 feet wide, running alongside and parallel with it. The gold contained in it is in a very fine state of subdivision, and the returns averaged from 5 to 10 dwt. of gold per ton, and at times as much as 15 dwt. of gold per ton.

Unlike the other reefs on Gympie, the gold appears to occur in the reef quite independently of its contact with the beds of black slate. Most of the workings on the Inglewood Reef are now abandoned.

The No. 2 Great Eastern Company for a time treated the stone successfully by the cyanide process, but on the reef becoming poorer it was found that the stone did not pay the cost of mining and treatment.

It is not, however, with the Inglewood as a workable reef that we are so much concerned as with the effect it has had, and will have, on the country and reefs coming in contact with it.

While the general trend of the reefs on Gympie is a little west of north, and east of south, and the strike of the country is nearly the same, the Inglewood Dyke runs in a west-north-west and an east-south-easterly direction. It is evident, therefore, that as it continues in an east-south-easterly direction it must come into contact with, and cut, the reefs and beds of country rock, and the question arose as to whether the Inglewood would cut through and displace the latter, or whether they would cut through the Inglewood.

It was thought by many on the field that, on account of their great size, the reefs in the Scottish Gympie Mines and in the No. 2 South Great Eastern would cut through and displace the Inglewood Dyke. That question, however, does not depend at all on the size of the reefs, but on their comparative age; the more recent always cutting through and faulting the older.

It is only of late years, as the workings on the reefs gradually extended further and further to the south-east, where the Inglewood Dyke would come in contact with them in the gold-bearing country, that this question has caused any uneasiness.

There can no longer be the slightest doubt that the Inglewood has had a great effect; and has cut off or displaced the reef and country to the south-west. This is clearly proved by taking the records of the shafts sunk to the south-west of the Inglewood Dyke, and comparing them with those of the shafts to the east or north-east.

The No. 2 Great Eastern Shaft, which is situated about 100 feet south-west of the Inglewood Dyke, was sunk to a depth of 714 feet. No detailed record of the country this shaft passed through was kept (a thing very seldom attempted in those days); but I was informed that no slate at all was cut in the shaft similar to that met with in the leases immediately north of the dyke, and I have not seen any slate in this lease until the Inglewood Dyke had been penetrated.

Calculating from the depths at which the top of the slate was cut in the old western shaft of the South Glanmire and Monkland, and in the western shaft of the No. 2 South Great Eastern, the top of the slate should have been met with in this shaft at a depth of about 380 feet, instead of which it is down 714 feet, and no slate was seen.

The shaft of the No. 3 South Great Eastern is somewhat east of the horizon, with reference to the strike of the rocks, to that of the new or eastern shaft of the No. 2 South Great Eastern, and in the same manner it is about 700 feet to the west of the shaft of the Scottish Gympie Gold Mines.

As the slate was struck in the former of these two mines at 980 feet in depth, and in the latter at 1,400 feet in depth, and allowing for the steeper dip of the rocks to the south of east on this southern portion of the field, the gold-bearing country should have been met with in the No. 3 South Great Eastern at a depth of between 1,050 and 1,100 feet had there been nothing between them to disturb the country. The shaft is now down 1,500 feet, and has not cut the slate.* Nor has the upper bed of limestone been struck. Now, this limestone bed is very persistent, and I have been able to trace it right away from north of the Chatsworth, beyond the Two Mile, to the No. 2 South Great Eastern, a distance of over six miles.

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* The present depth of the shaft is about 1,680 feet, the rock still being a diabase.—W.H.R., 19th October, 1901.

The limestone has an average thickness of 200 feet, and between the bottom of the limestone to the top of the slate there is an average thickness of 350 feet of intervening strata, as estimated in my First Report on the Gympie Gold Field, published in 1889, and since actually proved by the sinking of numerous shafts through the limestone to the slates on the eastern portion of the field.

In other words, the No. 3 South Great Eastern, if they were to cut the limestone, would still have to sink 550 feet to the top of the slate.

Now, as to the rocks through which the shaft has passed. Down to a depth of 600 feet the shaft passed through shales, while from that depth to its present depth (1,500), or for 900 feet, it has been in rocks totally unlike anything obtained immediately above the slate in any part of the field on the north side of the Inglewood Dyke.

These consist of greenish and purplish coloured rocks, very much altered, and somewhat difficult to determine. Examination of thin sections under the microscope show them to be very much altered eruptive rocks, with bands of tuff, the latter containing angular fragments of viridite, felspar, quartz, and an altered zoolite (?). The eruptive rocks resemble very closely the diabases found to the west on the other portions of the field; and may be classed as much altered diabases. Thin sheets or beds of diabase, of a few feet in thickness only, do certainly occur above the slate bed north of the Inglewood, but nothing anywhere approaching the thickness occurring here.

The position of the No. 3 South Great Eastern leaves no doubt as to its being on the south-western side of the Inglewood Dyke. If, however, further proof were wanting, we have it in the great similarity, both macroscopically and microscopically, of the diorite from the Inglewood Dyke, where it was worked from the old shaft of the No. 2 South Great Eastern at the 770-feet level, and from the crosscut into the dyke in the Scottish Gympie Gold Mines at the 1,420-feet level, which shows them to be one and the same thing. Moreover, the dyke was struck in the very position in the latter place that was expected by survey.

The next shaft to be mentioned is that of the No. 1 South Gympie Gold Mines. This shaft is about 5 or 6 chains east of the Scottish Gympie Gold Mines Shaft, on the line of strike of the beds; and it is now down to a depth of over 2,000 feet,* and has not yet cut the slate, which was met with in the Scottish Gympie Shaft at 1,400 feet. The beds in the latter mine are certainly dipping at a steeper angle than usual (1 in 3), but even allowing for a dip of 1 in 1, which is excessive, the slate should have been cut at a depth of under 1,800.

The limestone was passed through in the shaft at 1,155 feet, and a plumbago shale 15 feet thick at about 1,300 feet, and, judging from those facts, the slate should have been cut at about 1,500 feet, or 350 feet below the bottom of the limestone.

It would appear, therefore, from the record of this shaft that it must have started in the rocks lying to the north-east of the Inglewood, as down to a depth of over 1,300 feet the usual sequence of rocks are met with, but from 1,450 feet to the bottom of the shaft has been in a purple rock, which, examined under the microscope, proves to be an olivine diabase, amygdaloidal in parts. I have, since my visit, been shown a piece of rock said to have come from over 2,000 feet in depth. It is a hard, dark, green diabase, much altered, and coated with chlorite.

The rocks therefore passed through for about the last 600 feet point to a disturbance occurring somewhere between this shaft and the Scottish Gympie Gold Mines, the shaft of which is only about 13½ chains distant in a direction slightly west of north, and in which no rocks resembling this diabase were met with.

The two mines have been connected with a crosscut, and the Inglewood Dyke, if continued straight on from where it was cut in the southern drive of the Scottish Gympie Gold Mines, should cross this crosscut at about 350 feet north of the shaft of the No. 1 South Gympie Gold Mines.

The manager assures me that the dark-coloured diorite, which generally accompanies the Inglewood, was not met with, and I could see no trace of it in the crosscut, but at that point and also other places still nearer to the shaft there were walls with rubbly formation containing both quartz and calcite running and dipping in the same direction as the Inglewood Dyke.

The shaft of the No. 5 South Great Eastern and Oriental (the old Anglo-Saxon) is about three quarters of a mile to the south of that of the No. 3 South Great Eastern, and it is down over 1,000 feet, and has not cut the slate.

The above are the principal facts to be gained by a study of the shafts that have been sunk to the south of the Inglewood, and their relative positions, with reference to the known outcrop of the slates and limestone, and to the Inglewood Dyke, can be seen by a reference to the Geological Map of Gympie, on a scale of 4 chains to an inch, published by me in the year 1899.

The evidence obtained from the sinking of these three shafts—viz., the No. 2 Great Eastern, the No. 3 South Great Eastern, and the No. 1 South Gympie Gold Mines—proves most clearly that the gold-bearing country, or slate, does not continue in same direct line, on the south side of the Inglewood, as it has done on the north, and also, as the rock now being obtained in sinking those shafts is quite of a different character to any got above the slate on the north side, that the chance of cutting the Monkland slate, at any rate, on this part of the field is very small.

Limestone much resembling that of the upper bed, and which in my First Report on the field I took for granted was such, occurs in the bank of the river, about south-west from the No. 2 Great Eastern Shaft, but I could not trace it anywhere on the south side of the river. If, however, this is the limestone then the slate should occur beneath it, and should have been met with in the shaft of the No. 2 Great Eastern.

We now come to the consideration of the question as to in what direction the Monkland Slate is most likely to be found, supposing it does exist on the south side of the Inglewood Dyke.

Roughly speaking, the Gympie Beds run north and south and dip to the east, and as, as has already been shown, they do not continue in the same straight line on the south side of the Inglewood, it is evident that if they have been faulted they must have been thrown either to the east or to the west, as the general north and south strike of the rocks would not be much altered by the faulting.

* This shaft is now down to a depth of about 2,230 feet, and is still in diabase.—W.H.R., 19th October, 1901.

Now, referring again to the general structure of the field, as stated in the beginning of this report, the beds have been dislocated by numerous cross-courses or faults, running east and west, and dipping to the north, and these invariably have thrown the rocks to the east on their southern side, and in the two cases mentioned above for a very considerable distance. The small sketch map attached to this report shows the general structure of the field.

The Inglewood Dyke bears west-north-west and east-south-east, and dips to the north-north-east at an angle at about 1 in 10, and the beds should also be thrown by it to the east on its southern side.

The next point for consideration is whether there is any evidence in support of this assumption. In my first report on the Gympie Gold Field, 1889, on page 7, I refer to the occurrence of a bed of limestone east of the Imbil Road, which crops out in an old track leading to the Dawn Mine. This limestone is about a-quarter of a mile west of the Dawn Shaft, and was put down on Map No. 2, attached to that report, as probably the Lower Bed of Limestone. This is about 5 miles south of Normanby Bridge. Overlying that bed, and cropping out between it and the Dawn, are brown and yellow shales dipping to the east.

At the Dawn itself, and for some distance to the east, the country consists entirely of diabase somewhat altered, and containing phenocrysts of plagioclase felspar, augite, olivine, and magnetite, which closely resembles the diabase on the western portion of Gympie Proper.

Further to the east, near the southern bank of the river, Mr. Herbert Enright pointed out to me in Mr. Maynard's paddock an outcrop of calcareous sandstone, in places quite a mass of fossils. Immediately west of this there is a pebbly conglomerate. East of the fossiliferous bed is a baked bluish shale in which the fossil Productus cora occurs, and east of this again is another bed of pebbly conglomerate. I was unable to determine the thickness of each of these beds, as their boundaries were ill-defined at the surface.

The beds could be traced for about 250 yards in the direction of their strike, when towards the north they disappeared under the river alluvium, and to the south under a thick soil on the ridge, though in this direction pebbles and boulders were to be seen on the surface, evidently derived from a bed of conglomerate.

The fossils I collected were all of species found on the worked portion of the field, and the rock I found them in resembles closely the rock called "greenish fossiliferous sandstone" (coloured yellow on my map of Gympie, 1899), not only as regards the character of the rock, but also because in places it consists of one mass of fossils.

Some of the fossils were not sufficiently well preserved to identify, but among the better preserved ones I identified:—

Brachiopoda—

Productus cora, *D'Orb.*
„ semireticulatus, *Martin.*
„ brachythoerus? *G. Sby.*

Pelecypoda—

Aviculopecten subquinquelineatus, *McCoy.*
„ Sp. like multiradiatus, *Eth.*

Gasteropoda—

Pleurotomaria or Platyschisma (badly preserved).

About a mile south 20 degrees east of the above spot, after passing over country covered with thick soil, and a portion of it with dense scrub, I came upon a large outcrop of amygdaloidal diabase on a ridge and running down into a gully. Higher up the river, and on the opposite side from the outcrop of the fossiliferous rock, shales occur dipping in a south-east direction, and similar shales are seen along the Brisbane Road. These shales have the appearance of belonging to those that overlie and are outside the Gympie gold-bearing belt of country, and in fact they can be traced from here right through to them.

I could find no fossils at all in these shales, while the Gympie shales or slates are full of fossils.

The rocks here then occur in the following order, commencing from the lowest:—

Lower bed of limestone
Shales
Diabase
Fossiliferous calcareous sandstone
Conglomerates and slates
Overlying shales.

For comparison I give the general order of the principal beds only on the southern portion of the field—

Lower bed of limestone
Shales
Third bed of slate
Diabase
"Second" and "First" bed of slates, separated by about 100 feet of strata
Fossiliferous sandstone
The Phœnix and Monkland Slates
Third bed of conglomerate
Limestone
Overlying shales.

It will be noted that the sequence is very similar so far as the lower rocks are concerned, but I could not find any trace of the Monkland Slates or the Upper Limestone, although I traversed all the country where it was probable they would be met with.

Although the evidence given above does not conclusively prove that the beds described are part and parcel of the actual belt of the Gympie gold-bearing rocks, more especially as they could only be traced for short distances in the direction of their strike, yet I think there is sufficient evidence to warrant prospecting to the east on the south side of the Inglewood Dyke, which is the only direction in which, in my opinion, they will be found. The occurrence of the fossils mentioned is a matter of importance, for, though I have searched over most of the country around Gympie, I have never come across fossils in any quantity in rocks outside of the auriferous belt.

For the beds to have been thrown to the west there must have been a reverse fault, and that is a comparatively rare occurrence, and I do not remember a single instance on Gympie, where the cross-courses with a dip to the north have thrown the beds to the west. Moreover, if that had been the case I think the beds must have been met with in some of the numerous shafts on the south side of the river.

THE EASTERN GROUND.

Since the time that I first visited and reported upon Gympie the field has undergone an entire change so far as the position of the workings. Most of the mines to the west, which were then the principal gold producers, are either worked out and closed down, or are let on tribute to small parties of miners.

The shafts as a rule were shallow, and at that time there was only one shaft—the Great Monkland—that was down to a depth of 1,000 feet.

As these mines became worked out it was found necessary to go further and further to the east, where the slate lies at much deeper levels, and at the present date there are over twenty shafts down over 1,000 feet, and two—the No. 1 South Gympie Gold Mines and the West of Scotland—are over 2,000 feet in depth.

There is not the slightest doubt that the depression there has been of late years on Gympie is, to a great extent, due to the great number of deep and expensive prospecting shafts that have been sunk on the field all at one time, as the calls have generally exceeded the amount received in dividends from the mines on payable stone.

Most of the shafts are now nearly down to the depth it is necessary to go—that is to say, they have pierced the main gold-bearing bed of slate; and in some of them the work of opening out, by means of crosscuts, has already commenced, and I have still the greatest confidence that the eastern ground will give good results. In my first report I expressed this opinion, and many of the mines which lie away to the east of any that were in existence at that time have done well, and I see no reason why those situated still further to the east should not do likewise.

It must be remembered, however, that when a shaft has been sunk to a requisite depth to reach the slate, the prospecting is really only beginning, and it may be necessary, as so often was the case in the western mines, to do a large amount of dead prospecting work before payable stone is discovered.

There is a natural tendency for shareholders, after paying calls into a mine for some years for the purpose of sinking a deep shaft, to look for returns immediately opening out commences, forgetting that crosscuts very often cut reefs where they are small and poor, but on driving on them they may open out into good payable reefs. The instances of this have been very numerous on Gympie.

In the older days, with small shallow shafts, and inexpensive winding plants, the expense of sinking was a mere bagatelle; now the shafts are the greatest item of expense in the prospecting work. I merely mention this, perhaps self-evident fact, to point out that there should not be a despondent feeling because success is not attained at once.

In reporting on the eastern ground I did not think it necessary to visit the whole of the mines; but all the most important, and those having the most direct bearing on the future of the field, are described.

MOUNT WONGA.

The furthest point in a south-westerly direction that I visited was what is known as Mount Wonga, on the Keefton Estate, which is situated about 5 miles south-east of the Scottish Gympie Gold Mines, and comprises selection No. 871. This is outside the proclaimed goldfield.

Mr. Samuel Hester accompanied me to the property, and, after proceeding about 3 miles along the Brisbane Road beyond the bridge crossing the Six-mile Creek, we turned off to the left and ascended a ridge nearly to the top of Mount Wonga.

About twelve years ago three shafts were sunk here, the deepest of these was 90 feet. The country rock is a grey shale, with chloritic facets in parts.

The quartz at the surface which had been taken from these shafts was white, and rather of a barren-looking nature.

Three hundred tons were crushed, which are said to have averaged 13 dwt. of gold per ton. If this is correct, and the reef is of any size, it should pay well to work. The reef runs north-east and south-west.

Shales, sandstone, grits, and conglomerates crop out in a gully on this property, running in an easterly direction to the Mary River. The rocks are dipping east 8 degrees north at 40 degrees. A bar of dolerite occurs, apparently running parallel with the bedding planes of the slates. Rounded nodules of dolerite were seen in the gully.

Shales with a like dip occur along the Brisbane Road.

In the bank of the Mary River, on Hughs' Selection, west of Mount Wonga, there is an outcrop of shales dipping south 20 degrees east at 20 degrees, which probably belong to the overlying shales.

THE SCOTTISH GYMPIE FREEHOLD.

This property is situated just outside the boundary of the Gympie Gold Field, about a mile south-west of the Scottish Gympie Gold Mines. A three-chambered shaft is being sunk, which was down to a depth of 220 feet at the time of my visit. The following are the rocks passed through:—

Conglomerate and sandstone	surface to	15	feet
Yellow shale	15 feet to	42	„
Sandstone	42 „	66	„
Quartz and "formation rock"	66 „	71	„
Shale, showing slickensides	71 „	74	„
Grey pyritous shale	74 „	79	„
Pebbly conglomerate	79 „	89	„
Quartz and calcite with formation rock	89 „	102	„
Very pyritous shale	102 „	110	„
"Formation" rock with quartz leaders	110 „	128	„
Shales, pyritous in parts	128 „	208	„
Calcite and quartz in a formation rock	208 „	220	„

THE WEST OF SCOTLAND (Leases Nos. 1127 and 1128).

The leases comprise an area of 50 acres, and are situated immediately south-east of the No. 1 South Gympie Gold Mines Lease. The depth of the shaft is 2,110 feet, and it is 33 chains S.S.E. of the shaft on the last-mentioned lease.

The shaft passed through the overlying shales and sandstones from the surface down to 1,900 feet, with the exception of 40 feet, between 1,090 feet and 1,130, where it was in a reddish-brown dyke rock dipping south of west at an angle of 45 degrees. This rock, examined under the microscope, proves to be very much altered, but it evidently belongs to the diorite group.

At about 900 feet in depth a large formation was passed through, running its proper course of a little west of north.

Below the overlying shales was a fossiliferous sandstone, 42 feet in thickness; and then from 1,942 to 1,952 feet in depth, white quartz.

From 1,952 feet to the bottom, 2,110 feet, the shaft has been entirely in the limestone.

THE No. 1 SOUTH GYMPIE GOLD MINES (Lease No. 1033).

This is a lease situated immediately south of the Scottish Gympie Gold Mines.

I have already alluded at some length to this mine in the earlier part of this report.

The shaft since my visit has been sunk to a depth of 2,230 feet, and it is still in a greenish diabase.

The following rocks were passed through in the shaft:—From the surface down to 1,015 feet the overlying shales occurred; from 1,015 to 1,155 limestone; then 8 to 10 feet of plumbago shale; below that to 1,290 feet is what is described by the Manager as a dark rock full of mineral (pyrites). I did not see a specimen of this rock. Then from 1,290 to 1,305 feet was a bed of plumbago shale; next there was 20 feet of boulder conglomerate; somewhat altered rock, with beds of conglomerate, occurred from 1,325 feet down to 1,450 feet; and from that point to the bottom the shaft has been entirely in purple, grey, and green diabase.

At a depth of 1,426 feet a crosscut has been driven in a north-westerly direction, which has connected with the crosscut at the 1,424-feet level, from the Scottish Gympie Gold Mines.

At the shaft a number of leaders of quartz occur, bearing about north 30 degrees west, and at 60 and 140 feet respectively from the shaft there are two other formations of leaders.

At 75 feet and 110 feet respectively from the shaft there are rubbly formations with calcite running W.N.W. and E.S.E, against which these leaders are cut off, and another similar rubbly formation is seen in the crosscut in the Scottish Gympie Mine, about 350 feet from the shaft of the No. 1 South Gympie Gold Mines.

The crosscut was entirely in diabase from the shaft to the boundary, a distance of 160 feet, and on the top plumbago "break" of the slate in the Scottish Gympie Gold Mines, a distance of 610 feet. North-west of that is the slate.

If the "break" dipped at 1 in 1 from the point seen in the crosscut without any disturbance, it should have been cut in this shaft at 2,034 feet (1,424 + 610); but, if measured at right angles to the "break," which is the correct method of calculating, it should have been cut at 1,984 (1,424 + 560).

Below 1,000 feet formations were cut in the shaft at depths of 1,080 feet, 1,280 feet, 1,426 feet, and 2,170 feet respectively; the last of these is from 6 to 8 feet in thickness, dips to the east, and carries quartz on both walls.

THE SCOTTISH GYMPIE GOLD MINES (Leases Nos. 878 and 1025).

The area of each lease is 25 acres. This is the most southerly mine on the field at present on payable stone. At a depth of over 1,400 feet large deposits of quartz occur in splendid slate country; these are larger than any that have so far been found on the field. In one place at the 1,426-feet level there is an almost continuous width of nearly 300 feet of crushing material.

This mine has played a very important part in the development of this portion of the field, for not only was it the first to prove payable gold in reefs further east than any yet worked, but it also points to the extension of the field in a south-easterly direction north of the Inglewood Dyke. In addition to this the working of payable stone at a depth of 1,530 feet shows that in developing the eastern ground

there need be no fear that payable stone will not be found at the depth to which the shafts are at present being sunk to cut the slate, provided that the necessary conditions on Gympie are met with, viz., the slates and reefs in contact.

When this shaft was first started by what was known as the Eastern Monkland Company it was looked upon as a very "wild-cat" scheme; and it was not until the present company took it in hand that work commenced in real earnest, and eventually the top slate "break" was cut at about 1,400 feet.

1,348-FEET LEVEL.—A crosscut has been driven in a direction slightly south of east, and at 100 feet a large plumbago "break" was met with, which dips as usual a little to the south of east. The crosscut is entirely in "formation" rock—full of quartz leaders. A level was driven in a southerly direction below the break, where an immense body of quartz was worked in fine black-slate country. This has been worked south of the crosscut for a distance of about 200 feet, when it is cut off by the top "break" dipping underfoot. Nearly all the stone above this level has since been taken out.

This is quite a new feature on Gympie. The occurrence of rich gold-bearing stone on what are known as the "plumbago breaks," in connection with and between the two dislocated portions of a reef, is common. In this instance, however, the mass of quartz is far larger, and it is not apparently connected with any reef—at least, the work so far done has not shown it to be. The same break is 16 feet east of the shaft at 1,436 feet in depth, dipping east 25 degrees south at 32 degrees. Here, too, there is a large body of leaders in fine black rock. Fig. 1 shows the body of quartz on the "break."

Fig. 1.

BODY OF QUARTZ ON THE "BREAK" AT THE 1,348-FEET LEVEL, LOOKING SOUTH.

About 10 feet north of the crosscut from the shaft a fault occurs, running north-east and south-west, which throws the "break" a distance of 35 feet to the east going north.

The workings on Nos. 2 and 3 reefs at this level extend in a northerly direction as far as the boundary of the No. 2 South Great Eastern; and in a southerly direction to what is looked upon as the top "break," which on No. 2 reef is 240 feet, and on No. 3 reef 265 feet, south of the crosscut, and is here dipping east 65 degrees south at an inclination of 45 degrees, and bearing north 65 degrees east.

If this be therefore the same "break," or top of the slate bed, that has been followed all along the level, as it is supposed to be, then the whole thickness of the country rocks must have, in a few feet, been bent round at an angle of 40 degrees (the difference between east 25 degrees south, and east 65 degrees south), which seems almost impossible, as such a bend in so short a distance could only have been brought about by enormous forces, such that would have produced disturbances and dislocations of the strata far and wide, of which we have no evidence at all. It is far more probable that the so-called "break" in the latter case is a fault which has cut off the country to the south, and this supposition is supported by the fact that the rock to the south is of an entirely different character to that above the regular break to the north, as is proved by the workings of the No. 1 South Gympie Gold Mines, and of the No. 3 South Great Eastern (see pages 2 and 3 of this report).

In this report I shall continue to use the term "break" in referring to this, for the purpose of being better understood by the miners and those who know the field. This "break" limits the extent of the gold-bearing country to the south at this level.

These reefs going south widen out into large formations, many yards in width, consisting of a mass of leaders and bands of quartz in a slaty rock. The whole width of "formation" material went to the mill, as it was impossible to pick out the slate from the leaders on account of their great number. The whole mass averaged about 13 dwt. of gold to the ton.

1,426-FEET LEVEL.—The Nos. 2 and 3 Reefs were met with in a crosscut at 200 and 290 feet respectively west of the shaft, and most of the stone now being crushed is coming from this level and the stopes above it. They have been worked in a northerly direction to the northern boundary, and on No. 2 Reef a winze is being put down on good stone to the 1,529-feet level at a point about 30 feet from the No. 2 South Great Eastern boundary.

Going south they widen out and almost merge into one, and near the top "break" there is a large chamber nearly 300 feet across.

On the No. 2 Reef the "break" dipping east of 65 degrees south at 45 degrees occurs about 330 feet south of the crosscut, cutting off both the reef and country to the south. A winze is being sunk on the "break," and was down about 40 feet. It was in good slate country.

The level on No. 3 Reef met the Inglewood Dyke at about 200 feet south of the crosscut, and the reef is completely cut off thereby. The dyke is running in its usual direction of E.S.E. and W.S.W., and is dipping to the N.N.E. at about 10 degrees from the perpendicular. On its northern wall there is a rubbly formation and then a diorite. Drives are being put in each way along the dyke, and it will be important to see what has occurred when the Inglewood meets the top "break" in the southern drive.

From this level an immense amount of stone, averaging about 14 dwt. of gold per ton, has been obtained.

Fig. 2.

No. 2 REEF AT THE 1,428-FEET LEVEL.

In the crosscut at this level to the No. 1 South Gympie Gold Mines the top "break" or fault is met with dipping east of south at about 40 degrees. Beyond the "break" the rock consists of greenish and purplish altered diabase with tuffs.

At about 240 feet along the crosscut there were walls with calcite, running and dipping in the same direction as the Inglewood Dyke, and similar walls occur further along it.

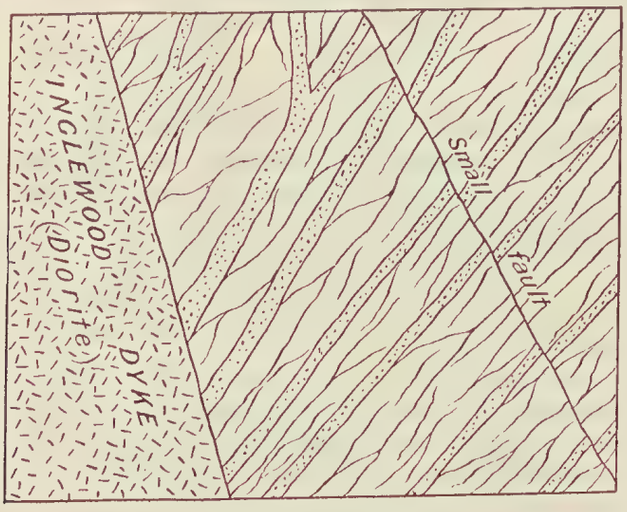
On nearing the boundary of the No. 1 South Gympie Gold Mines, and again in that lease itself, 75 feet from the shaft, there are leaders of quartz and calcite bearing north-north-west, and dipping towards the west, which is the general strike and dip of the Gympie Reefs.

1529-FEET LEVEL.—I descended to this level by means of a "blind" shaft or winze, though it is now connected with the main shaft by a crosscut running in a south-westerly direction.

The Inglewood Dyke is about 100 feet west of the "blind" shaft, and about 15 feet north-north-east of its position in the 1428-feet level. In places there is from 3 to 4 feet of rubbly material on its northern wall, while in others the reefs abut right up against the diorite.

A drive was going in a west-north-westerly direction along the wall of the dyke, and the following sketch (Fig. 3) shows the reef cut off by the dyke, and also the structure of the reef formation, showing a mass of bands, leaders, and strings of quartz in good slate country.

Fig. 3.



Sketch of Reef and Inglewood Dyke in the West-north-westerly Face of Drive along Inglewood Dyke at the 1,529-feet level.

To describe the character and size of the reefs at this level would be merely to repeat what was said about them at the 1428-feet level.

The following table gives the returns from the commencement of crushing to the end of the year, 1900:—

	Tons.	Oz.	dwt.	Dividends.
1897	2,820	1,652	14	Nil.
1898	15,199	10,147	2	£2,250
1899	27,105	17,683	9	£11,250
1900	40,290	25,682	19	£36,750
1901 (to end of June) ...	25,288	15,344	10	£16,500
Total	110,703	70,510	14	£66,750

From the foregoing description of the mine it will be readily understood what immense bodies of stone there are to deal with; in fact, the work already done can only be looked upon as a little more than the commencement of what there is to do.

The mining plant and machinery is all that could be desired. The winding plant and poppet-heads are the finest on the field. The cages are double decked, owing to the smallness of the shaft, which only has two chambers, 3 feet square each.

The company own a 100-head battery, which is erected adjacent to the shaft, and the stone, after passing through stone breakers is taken by an overhead tramway direct to the "shoots," which feed the battery by means of self-feeders.

The water for the battery is obtained from a dam constructed close to the mine; but pipes have been laid down to a pumping station at the river, so that there is no chance of work ever being stopped for want of water.

The whole of the crosscuts and levels are lighted by the electric light, produced by a fine electric plant at the mine; and the underground winding engines for sinking winzes, &c., and the rock drills, are driven by electric power. The company also, I understand, supply electricity for lighting purposes to several of the surrounding mines.

Everything is in good working order, and from all appearances this mine has a long life before it.

THE No. 2 GREAT EASTERN (Leases Nos. 915 and 1105).

The area of the two leases together is 50 acres. The workings in this mine have been described in each of my previous reports. I did not visit this mine on my recent visit, but I was over it some two years ago, when I made the following notes which have not yet been published:—

Development work in this mine has been confined to the Inglewood Reef. As a rule the payable stone in the Inglewood Reef has occurred in patches, and the expense of searching for these has always proved too great.

The Manager, Mr. Parkyn, informed me that between the 420-feet and 700-feet levels the stone would average about 10 to 12 dwt. per ton. A cyanide plant was erected in connection with the battery to treat the tailings, but unfortunately the expense of treatment swallowed up the value of the gold obtained. The battery itself has since been sold to the South Monkland and Glanmire Company.

In my Third Report on the Gympie Gold Field I refer to a patch of plumbago shale in the form of a casing to the reef which was met with on No. 3 Reef, at the 420-feet level, in connection with which over 3,000 oz. of gold was obtained. Further development shows that a plumbago casing occurs pretty generally down to the 700-feet level on the eastern wall, not only on this reef, but also on the Inglewood.

THE No. 2 SOUTH GREAT EASTERN (Lease No. 721).

The area of the lease is 25 acres. Descriptions of the workings were given in my Second and Third Reports on the field.

When I wrote the latter of those reports a crosscut was being driven in a south-westerly direction at the 775-feet level to cut the Inglewood Reef to the south of the No. 2 Great Eastern. The slate country was met with in this crosscut sooner than was expected.

On working the Inglewood Reef, however, the crushings did not come up to expectations, and the workings on that reef were abandoned.

A branch crosscut was then driven in an east north-easterly direction for 400 feet, and for a long distance this was in good slate country with plumbago floors. At 400 feet a reef was cut, which is now known as the No. 1 Reef, but this must not be confused with the No. 1 Reef in the Scottish Gympie Gold Mines, as it is situated several hundred feet to the west of that. The eastern reefs have no particular names, and are generally numbered 1 and 2, &c., in the order they are found in the particular mines. This reef has been traced through and worked in the Oriental and Glanmire, and in the No. 1 North Oriental and Glanmire. When the reef was cut in the crosscut it was above the slate country, and a winze was sunk on the reef for 120 feet, or a vertical depth of 100 feet, and levels were opened out both north and south at the bottom of the winze. This winze, after being sunk for some distance by means of a windlass, was worked by electric power. The slate country came into the winze at a depth of about 70 feet from the 770-feet level.

The winze was afterwards continued to below the bottom of the slate, and levels were opened out on it. The reef was a big one, in places over 15 feet in width, and at times very rich.

It was apparent that the reef could not be worked economically from the winze, and a new shaft was put down to the east, at a point about a chain west of the Brisbane Road, from which both this and the Scottish Gympie Gold Mines Reefs, lying away still further to the east, could be worked.

This shaft has been sunk to a depth of 1,475 feet.

Crosscuts were put in at the 870-feet and 970-feet levels in a westerly direction to connect with the levels on the No. 1 Reef.

Very little work is being done on this reef now, but it has paid about £77,000 in dividends.

970-feet Level.—At the shaft at the 970-feet level a dyke of diorite runs in an east and west direction and crosses the reef about 50 feet south of the crosscut. This is the dyke seen in the first railway cutting south of the Monkland Station, shown on the geological map of the field, 1899.

At 410 feet south of the crosscut the Inglewood Dyke is met with. On the northern wall there is 1 foot of a rubbly material, then 37 feet diorite, dipping steeply north-north-east, and on the southern side of the diorite is a rubbly "formation" about 5 feet in width.

At about 200 feet south of the crosscut the level branches off into two, the left-hand or western one following the reef under the bottom "break," which throws the upper portion of the reef 20 feet to the east. About 70 feet along this level the "break" dips under foot, and the level following it is changed into an underlie.

The reef here is about 10 inches thick, showing some gold. This underlie will be sunk to the Inglewood Dyke, when the reef will be worked up to the level.

The slate here is 40 feet lower on the footwall than on the hanging-wall.

1,100-feet Level.—The diorite dyke occurs at the shaft at this level also, but it is on the northern side of the shaft, having dipped about 20 feet to the north between this and the 970-feet level, but between this and the 1,230-feet level it is nearly perpendicular.

Immediately south of the dyke the slate beds are dipping south of east at an angle of about 40 degrees.

A crosscut has been driven at this level in an easterly direction, and at 124 feet east of the shaft a winze has been sunk perpendicularly, in which, at 30 feet in depth, the No. 2 Reef is met with, which was in the shaft at 1,210 feet in depth. The crosscut was continued to 134 feet, when a drive was put in to the south; after driving a few feet the reef was met with, and followed to the diorite dyke bearing east and west, which is being driven through to connect with the "rise" north of the dyke from the 1,230-feet level. The slate in this drive was dipping south of east at 28 degrees.

1,230-feet Level.—The diorite dyke is at the shaft, having come down perpendicularly from the upper level.

In the southern level, which is about 25 feet west of the shaft, there is a very large reef. On the bottom "break" there is from 40 to 50 feet of crushing material, and it is from here that nearly all the stone is being raised.

There are two "breaks" here, one a little above the other. The lowest, which dips as usual south of east, displaces the upper portion of the reef about 20 feet to the east, while the upper one, which dips in the same direction, throws the reef back the reverse way so that the top portion is nearly vertically over the lower. The reef above the upper "break" is nothing like so flat as below, and it is in places 20 feet in width, consisting of a formation of black rock and slate, with bands and leaders of quartz throughout it.

North of the dyke of diorite a rise was being put up to connect with the drive from the eastern crosscut at the upper level; when this has been done the reef north of the dyke will be worked, and a greater number of head of stampers will probably be kept going. There is now a good-sized reef carrying payable gold.

A crosscut was being driven in an easterly direction at this level in good slate country, with fine plumbago floors and seams of pyrites. At 110 feet along this crosscut a reef from 10 to 15 inches in width was cut, carrying good gold. This is known as No. 3 Reef. This reef has been driven on north and south for some feet, and has increased in size up to 18 inches, and it carries payable gold.

1,450-feet Level.—A chamber has been cut out here, and a drive started to the east to intersect the reefs of the Scottish Gympie Gold Mines in the slate, all of which lie to the east of the No. 3 Reef.

The returns from this mine, since the No. 1 Reef was discovered in the year 1897 to the end of June, 1901, are as follow:—

	Tons.	Oz.	dwt.	Dividends.
1897	939	1,473	9	£1,600
1898	8,028	8,549	4	£10,735
1899	7,582	15,303	14	£32,800
1900	13,606	16,893	15	£32,942
1901 (to end of June)	7,764	7,496	3	£12,000
Total ...	37,919	49,716	5	£90,077

The company are at present crushing with 40 head of stampers, but as soon as the No. 2 Reef, north of the diorite dyke is opened up and No. 3 Reef is developed, a much larger output may be looked forward to, with increased dividends.

THE SOUTH GLANMIRE AND MONKLAND (Lease No. 833).

The area of this lease is 21 acres. When I last reported on this mine, work was being carried on from the old or western shaft. A new shaft has since been sunk, about 1 chain west of the Brisbane Road, to a depth of 1,032 feet.

851-feet Level.—In an easterly crosscut; a small bed of slate, 5 feet in thickness, was cut at 100 feet east of the shaft, which was passed through in the shaft 83 feet above the level. In this crosscut three reefs were met with—the first at 220 feet, the second at 485 feet, and the third at 555 feet.

The bottom of the main bed of slate comes into the crosscut 350 feet east of the shaft.

In driving on the No. 2 Reef, at 30 feet north of the crosscut, a fault, which crosses the crosscut further back, displaces the reef 2 feet to the east; and north of this crosscut diorite takes the place of the slate as the "formation" rock between the walls.

On the No. 3 Reef this fault is 50 feet north of the crosscut.

At 600 feet east of the shaft the country is disturbed by a fault dipping west 10 degrees north at 30 degrees. East of this the country is very much contorted for some distance, and then dips very steeply to the east.

990-feet Level.—The crosscut at this level has been driven to the east for a distance of 842 feet.

The country at the shaft consists of a hard, grey diabase, and it is about 145 feet below the bottom of the slate.

The No. 2 or West Oriental Reef is 390 feet east of the shaft, and the slate on this reef is about 80 feet above the crosscut. This reef has been worked along the bottom "break" by means of an intermediate level connected with this crosscut by a winze.

At 100 feet further along the crosscut, or 490 feet from the shaft, the No. 3 Reef occurs. This is the same as the old reef or No. 1 Reef in the No. 2 South Great Eastern. The bottom "break" is seen on the eastern or footwall side of the reef in the crosscut. The slate on the hanging-wall side being 50 feet higher up. The "break" is dipping at 35 degrees a little south of east. In the crosscut there is a large formation 16 feet in width. It is from this reef that the rich stone is being raised. At about 60 feet along the southern level there is a small cross-course, which displaces the reef a little. Good gold was got on the break as far as this crosscut, but south of it the slate was grey and much less gold was seen, and on the footwall the reef was split up into small leaders, and some of the hanging-wall quartz was stripped but did not show a colour of gold. The level is in 285 feet to the south, but the bottom "break" had not yet come in on the hanging-wall.

At the end of this level a "rise" has been put up 27 feet, where an intermediate level is being driven in a southerly direction on a large body of quartz showing colours of gold. The junction of No. 2 and No. 3 Reefs is seen here.

On ascending the stopes in a northerly direction there is a large reef with gold showing in places.

At 190 feet south of the main crosscut a small crosscut has been driven from the stopes to intersect the No. 2 Reef, which is here 30 feet west of No. 3. This would be about 90 feet in vertical height above the level. The No. 2 Reef is about 4 inches in width only, and a level has been driven to the boundary of the Oriental and Glanmire. This reef will be worked by a crosscut put in lower down the stopes, as at this level it is above the "break."

What is called the New Reef, and which may be the No. 2 of the No. 2 South Great Eastern, was met with in the crosscut at 835 feet from the shaft near the top of the slate.

It was just being opened up, and had been driven in for a few feet north and south, and a winze is being sunk at 15 feet along the southern level by the side of the cross-course. The cross-course runs west 25 degrees south, and displaces the reef 2 feet to the west going south. The reef bears north 15 degrees west, and underlies at 30 degrees towards the west, and it consists of good-looking quartz about 1 foot in width.

On the hanging-wall there is a dark green diabase, and on the footwall grey slates with plumbago floors.

The crushings and dividends from this mine during the last few years have been as follow:—

	Tons.	Oz.	dwt.	Dividends.
1896	3,216	2,395	9	Nil.
1897	3,872	3,942	2	£2,250
1898	3,746	3,113	10	Nil.
1899	9,651	9,231	0	£12,250
1900	14,713	10,049	0	£8,500
1901 (to end of June) ...	7,246	4,628	0	£7,750
Total	42,444	33,359	1	£30,750*

* Since the end of June this mine has paid 9s. 6d. per share, equal to £28,500.—W.H.R., 19th October, 1901.

THE ORIENTAL AND GLANMIRE (Lease No. 1000).

The area of the lease is 25 acres, and it is situated to the east and north of the South Glanmire and Monkland Lease.

This mine was first worked from a shaft put down in the north-west corner of the ground.

At 920 feet in depth, a crosscut was driven to the west for a distance of 58 feet to the Oriental Reef, which is the same as the No. 3 Reef in the South Glanmire and Monkland, with which it was connected by a southern drive. This was a large formation with a little quartz on the hanging and foot walls. Going north the quartz was very small. Just west of the shaft there was a diorite dyke dipping steeply to the west.

A crosscut was driven also to the east for 550 feet, and at 250 feet the eastern reef (East Oriental) was met with. This reef consisted of a large "formation" of slate with leaders and veinlets throughout it, and at times large masses of quartz.

Immediately east of this reef the slate dips very steeply at an angle of 45 degrees.

Levels were driven both north and south, and a winze was put down from the southern drive to a depth of 134 feet, where there were 8 feet of solid quartz. Most of the stone crushed came from this reef. The returns are :—

Year.	Tons.	Oz.	dwt.	Dividends.
1897 ...	1,987 ...	3,449	8 ...	£1,800
1898 ...	5,296 ...	5,420	19 ...	3,600
1899 ...	9,212 ...	7,696	0 ...	6,600
1900 ...	5,222 ...	3,528	0 ...	600
Total ...	21,717 ...	20,094	7 ...	£12,600

The western shaft at the time of my last visit was closed down, and work was going on from the new shaft about 70 feet to the east, which had been sunk to a depth of 1,310 feet.

The top of the slate came in at 1,077 feet in depth.

1,080-feet Level.—In a crosscut driven to the west, a reef was met with at 120 feet. It is about 5 feet in width, and consists of diorite with a small leader of quartz on the footwall. This was driven on to the south for 30 feet, but did not improve in size.

At 123 feet from the shaft another "formation" was met with, consisting of leaders of calcite in good slate country; but no gold was seen in the crosscut. A level has been started to the south, and a drive was put in 10 feet to the east to the footwall where there were 2 feet of leaders carrying a little gold.

An east and west cross-course runs along the crosscut.

1,190-feet Level.—At this level a crosscut is being driven to the west, its length is 62 feet.

1,290-feet Level.—A crosscut, 220 feet in length, was being driven to the east. The top of the slate country was at the end of the crosscut, and the bottom was in the shaft at 1,265 feet in depth, so that it is evident that it has come down much quicker than it should have done, as in the shaft the slate is 188 feet in thickness. About 200 feet from the shaft, along the crosscut, there is a fault, running north and south, and dipping to the east, which has evidently thrown the country down to the east, and this may account for the top "break" being met with so soon in the crosscut.

At 168 feet east of the shaft there is a large "formation," 15 feet in width, consisting of black slate and sandstone, with leaders of quartz all through it. This is probably the No. 3 Reef of the Scottish Gympie Gold Mines. East of this reef the country dips at an angle of 45 degrees as far as the fault, beyond which it dips at 30 degrees.

This reef is now being opened out on by levels north and south, and there is a large body of crushing stuff carrying a little gold.

The rock at the shaft of this level is a hard purple diabase.

THE ORIENTAL CONSOLS (Leases Nos. 1206 and 1218).

The area of the leases together is 50 acres. The shaft, which is situated nearly 1,500 feet east-north-east of the Scottish Gympie Gold Mines Shaft, is down 900 feet in the overlying shales and sandstones. One belt of diorite was passed through.

It is estimated that this shaft will have to be sunk to a depth of about 2,200 feet to the slate; but if the country continues to dip at a steeper angle, the slate will not be met with until a greater depth is reached.

Leaders of a few inches in width were passed through at 351, 685, and 996 feet in depth; and two reefs, each 2 feet in width, at 511 and and 867 feet in depth respectively.

THE No. 1 SOUTH ORIENTAL AND GLANMIRE (Lease No. 1027).

The area of this lease is 15 acres, and it is situated south of the Oriental and Glanmire, and east of the No. 2 South Great Eastern.

The shaft is down over 1,700 feet. It started in the overlying shales and sandstone, and passed through the limestone at a depth of 1,418 feet, below which was a bed of plumbago shale 4 feet in width, and then amygdaloidal diabase 40 feet thick, and then shales and sandstone for 70 feet. At the present depth they are in black mineralised sandstone, with plumbago shale floors. This is the auriferous country known as the Monkland Slate.

Several formations, I was informed, were passed through in sinking; one at 107 feet in depth was about 8 feet in width, with quartz carrying galena and iron pyrites. In conjunction with this reef there was a dark-coloured shale at this level on which the reef made a "break" of 15 inches. No gold, however, was obtained. This is probably the same shale met with in the pump shaft of the Scottish Gympie Gold Mines.

The Manager also reported cutting from 8 inches to 1 foot of quartz at 420 feet in depth; a diorite dyke 2 feet thick at 968 feet, and another of 6 feet at 1,196 feet; and two small leaders of good-looking quartz, 4 inches and 6 inches thick, at 1,485 feet and 1,572 feet in depth respectively.

This mine will soon be in a position to open out crosscuts in search of reefs.

THE EAST ORIENTAL AND GLANMIRE (Leases Nos. 1122 and 1123).

The area of the two leases together is 50 acres. The shaft is now down 1,900 feet. The limestone in this shaft was 200 feet in thickness, and was passed through at 1,300 feet. Beneath it there were shales and boulder conglomerate, and at 1,736 there were 34 feet of amygdaloidal diabase. At 1,880 feet the manager reports having cut the Monkland slate, and in the bottom of the shaft there are good plumbago shale floors.

The following reef formations were reported by the manager to have been passed through in the shaft. At 380 feet in depth a reef 8 feet between the walls; at 640 feet a formation 2 feet wide; at 1,354 feet a reef formation, 6 feet in width, consisting of quartz and chlorite; and from 1,780 feet to 1,800 feet in depth the shaft was in a reef formation.

THE No. 1 NORTH ORIENTAL AND GLANMIRE (Lease No. 1109).

This is a 25-acre lease, situated immediately north of the Oriental and Glanmire. This mine was first worked from the shaft of the No. 1 North Great Eastern. The ground in which the western reef was worked, which is the same as the western reef in the Oriental and Glanmire and the No. 2 South Great Eastern, formerly belonged to the No. 1 North Great Eastern Company; but the latter company having done a large amount of unprofitable work, owing to financial difficulties, threw up 9 acres of the eastern portion of their lease to save the labour conditions.

The eastern crosscut of the No. 1 North Great Eastern, at 900 feet in depth, was continued into this lease, and at 200 feet east of the boundary the reef was cut. At the point of intersection the reef was not of too promising a character, but it improved greatly in a winze that was sunk from the level immediately south of the crosscut. The country in the winze, and also in the formation, was black slate but on going down the formation changed into a grey sandstone, which came in wedge-shaped from the footwall. In the upper part of this winze the quartz was much broken up, but for the last 50 feet there was a solid body of quartz.

At 135 feet down the winze, levels were opened up north and south on a large body of quartz containing galena and pyrites, which, however, got smaller in the southern drive.

Some very rich specimen stone was obtained from the first 20 feet of the northern drive on the hanging-wall, but a small fault came in running north-east and south-west and dipping north-west. On the northern side of this fault the hanging and footwall reefs came together, and were in grey slate country. The rich vein of gold from which the first crushing came did not continue.

A new shaft was started nearly 300 feet east of the western boundary of the lease, which is now down 1,225 feet, and the reef is being worked from the 1,116-feet level. This reef is providing the crushing material.

The following are the returns from this mine:—

	Tons	Cwt.	Oz.	Dividends.
1898	990	5	2,365	£4,800
1899	1,806	14	1,754	Nil
1900	3,974	9	3,120	1,200
1901 (to end of June) ...	2,724	11	3,181	4,800
Total	9,495	19	10,410	£10,800

A crosscut has been driven to the east at the 1,116-feet level for most of the way in black rock and slate. At 265 feet east of the shaft 3 inches of quartz carrying colours of gold was cut, and risen on for a few feet in which the "formation" was about 3 feet in width with veins of quartz from 1 to 6 inches thick.

At 314 feet east of the shaft the Manager reports cutting a reef formation with about 18 inches of quartz. A winze has been sunk on it to a depth of 80 feet. The reef broke away at a depth of 56 feet, and the sinking is going on in the "formation." The reef while in the winze was carrying fair gold.

I did not go down this mine during my last visit.

THE NORTH ORIENTAL AND GLANMIRE (Lease No. 1066).

This is a 25-acre lease, situated north of the No. 1 North Oriental and Glanmire, and east of such well-known mines as the No. 1 North Glanmire, the North Glanmire, and the No. 1 North Oriental and Glanmire.

The True Blue Reef crops out in the ground, and can be traced north and south for many chains.

For the first 700 feet the shaft was in the overlying shales, with beds of sandstone at 288 feet and 416 feet respectively; and at some little depth below that the limestone which was about 250 feet in thickness was met with.

The shaft has been sunk to a depth of 1,699 feet, and the top of the Monkland Slate was met with at about 1,440 feet.

The Manager reports cutting a large number of reefs and formations in sinking the shaft, viz.:—A reef consisting of quartz and chlorite 3½ feet thick at 260 feet in depth; a reef formation 8 feet wide at 317 feet in depth; some good-looking quartz at 416 feet; a reef 3½ feet wide all quartz at 543 feet; another of 5 feet thick at 552 feet in depth; at 600 feet a reef 8 feet in width of solid quartz; at 630 feet a large reef of solid quartz; at 795 feet a reef 2 feet 6 inches wide; one of 5 feet at 1,050 feet in depth; and one of 2 feet at 1,281; at 1,300 feet the shaft passed through 12 inches of quartz; at 1,425 feet there was a large reef formation, with leaders of quartz from 1 inch to 6 inches in width,

which was worked from 1,628 feet in depth by the Queen's Oriental; at 1,647 feet there was a small leader of quartz; from 1,673 to 1,682 feet in depth there was a "formation" of leaders, and at 1,691 and 1,695 feet there were two quartz leaders of 6 inches and 4 inches respectively.

1,320-FEET LEVEL.—This is about 120 feet over the slate. A crosscut has been driven to the west for over 100 feet. Near the shaft there were 10 inches of quartz in the roof of the crosscut, but it had dwindled down to almost nothing in the floor; this is what was passed through at 1,300 feet.

The rock in the crosscut is very much altered, probably a diabase.

1,480-FEET LEVEL.—In the western crosscut at 45 feet a small reef formation was cut, with bunches of quartz up to 4 inches in width. No gold was seen in the reef. On the hanging-wall or western side of the reef there is 8 feet of diorite.

The crosscut at the shaft is about 40 feet below the top of the slate.

At 188 feet west of the shaft there is another very small reef "formation," with only a scale of quartz. This showed a fine colour of gold. The bottom of the slate was 280 feet from the shaft, dipping a little south of east at 35 degrees.

1,600-FEET LEVEL.—A crosscut has been put in to the west. At the shaft the country is slate. At 20 feet west of the shaft there is a "formation" 4 feet in width, with a tiny leader of quartz in it, which carries gold. The slate went overhead at 25 feet from the shaft. A southern drive was put in for about 35 feet, and gold was found all the way along until the reef was cut off by a cross-course.

1,658-FEET LEVEL.—In an eastern crosscut, that has been started here, the bottom of the slate comes in 26 feet east of the shaft, and is dipping at the steep angle of 45 degrees.

THE COLUMBIA CONSOLIDATED (LEASES NOS. 1092 AND 1093).

Together these leases comprise an area of 50 acres situated immediately east of No. 1 North Columbia Smithfield.

A three-chambered shaft has been sunk to a depth of 1,775 feet.

From the surface to about 950 feet in depth the rocks consisted of shales and sandstones known as the "overlying shales"; at a depth of 85 feet there was a small plumbago shale floor, and below that came in a black shale with iron pyrites on the facets of the joints. At 100 feet there was a bed of black shale, 18 inches in thickness, and containing iron pyrites and plumbago throughout it, and the shales are darker with plumbago floors for 30 feet below this. Although this bed is part of the overlying shales, it is of such a good-looking character, and so much resembles the gold-bearing shales or slates to the west, that I can see no reason why on this new horizon, reefs in contact with it should not carry gold; at any rate the experiment seems well worth trying, more especially as a reef is known to occur not far to the east.

Below the overlying shales was the limestone about 150 feet thick, and then the bed of conglomerate. The upper plumbago "break" was met with in the shaft at 1,470 feet in depth, and continued in it down to 1,576 feet.

The following reefs and formations were reported by the Manager during sinking:—A quartz reef 2 to 3 inches thick at 286 feet; at 418 feet a floor was cut with about 6 inches of quartz on it; under the floor there was a reef 18 inches thick, with 6 to 7 inches of solid quartz, the remainder contained small leaders. At 664 feet a formation was met with 3 feet 6 inches wide consisting of quartz leaders and chlorite; at 1,250 feet a reef with 2 inches of quartz on hanging-wall, and 3 to 6 inches on footwall which seemed to be increasing in size as it went out of the shaft. At 1,578 feet there was a flat reef of from 2 to 4 inches thick, showing colours of gold; at 1,684 feet a leader of quartz and calcite was cut, and 4 feet in from this is a mullocky formation from 3 to 6 inches thick; lastly at 1,717 feet a formation came in consisting of 18 inches to 2 feet thick of calcite and quartz on the hanging-wall, and 3 to 4 inches of good-looking quartz on the footwall.

At 1,504 feet a crosscut has been started in a westerly direction, which has now been driven about 135 feet in a sandstone and conglomerate, with black rock and slate coming up in the floor at the face.

At 1,576 feet a crosscut is being put in to the east, which is about 140 feet in length. A reef was cut in this, and it has been driven on, and a rise put up 33 feet, in which there is 18 inches of quartz on the hanging-wall.

At 1,750 feet a crosscut, now 40 feet in length, is being driven to the east. The rock is diabase.

The leases are in a good position, lying due east of such well-known mines as the No. 1 North Phœnix and the North Smithfield.

There is a very fine winding plant, and everything is in readiness to carry on the work of prospecting and development.

THE ORIENTAL AND COLUMBIA CONSOLIDATED (LEASES NOS. 1182 AND 1183).

The two leases comprise together an area of 50 acres, situated immediately north of the Columbia Consolidated. These leases lie away to the east of mines that have done well in the past, such as the No. 4 North Phœnix, Phœnix Golden Pile, and the Smithfield and Phœnix Golden Pile.

The depth of the shaft is 1,431 feet. The shaft started in the overlying series of shales, and from 75 feet to over 100 feet a few plumbago floors were met, though a good deal of what was taken for plumbago was in reality a dark greenish-black chlorite. This mineral is often mistaken on Gympie for the polished plumbago, but the two are very readily distinguished, as plumbago on being scratched with a knife leaves a dull black streak, while the chlorite gives a white streak.

At 560 feet two cross-courses junction in the shaft, and the overlying shales change into sandstone.

Limestone is reported to have occurred in the shaft from about 620 feet to 940 feet, while at 650 feet in depth a fault was met with, dipping north-east at 45 degrees, and at 750 feet a diorite dyke. Below the limestone boulder conglomerate occurred down to 1,260 feet, and in it were four beds of plumbago shale—at 950, 976, 1,016, and 1,078 feet in depth respectively. Then there were altered rocks from 1,265 feet to 1,337 feet; and from 1,337 to 1,380 a black slate occurred.

Below that there is pebbly conglomerate for a few feet, and then what is called conglomerate, but what is probably an altered sandstone. At 1,408 feet there was a cross-course, dipping to the north.

This shaft should be continued, as I am very doubtful whether all the slate has been passed through.

The Manager reports passing through the following formations and reefs in sinking the shaft:—

At 327 feet in depth, a reef formation 2 feet thick; at 480 feet, another of 2½ feet thick; at 640 feet, a reef formation 2½ feet thick; at 818 feet there was 6 inches of calcite and quartz; at 1,030 feet, 4 inches of good quartz; at 1,228 feet, a leader of from 1 to 3 inches thick; and at 1,337, two small leaders carrying colours of gold.

Two crosscuts have been started in a westerly direction—one at 1,335 feet and the other at 1,377 feet in depth. At 10 feet west of the shaft, in the 1,377-feet crosscut, some leaders were met with, and drives were opened out north and south. The northern drive is in about 60 feet, and in the southern drive, after going about 24 feet, a cross-course was met with, which displaced the reef. After getting through this, a crosscut was put in west to pick up the reef. This is in 11 feet, but has not yet cut it. Colours of gold were seen in places in both drives. A "rise" is, I understand, being put up on the reef just north of the cross-course in the southern drive, where the best gold was seen.

The main crosscut is now in about 150 feet, and it passed through chiefly a grey sedimentary rock and pebbly conglomerate. At 138 feet a formation 18 inches in width was met with, with from 1 to 3 inches of quartz and calcite. Nothing yet has been done on this latter reef, which throws the country down on the west. A group of mines to the north-west of this, viz:—The Australasian, the No. 1 North Victory, and the No. 3 North Smithfield, although a large amount of work has been done, and money spent on them, have so far been very disappointing. I did not visit them.

THE No. 2 NORTH VICTORY (Lease No. 1081).

This is a lease of 25 acres, situated north-west of the No. 1 North Victory. The total depth of the shaft is 823 feet, and sinking is being proceeded with, and is at present in diabase.

Down to a depth of 250 feet the shaft was in overlying shales dipping to the S.S.E., like those in the railway cutting near by. These shales are north of the line of fault, shown on my Geological Map of Gympie, 1899, which has bent the shales here round from their regular easterly dip.

At 250 feet a dyke of diorite comes in, dipping to the north-east, and this was followed for some distance in sinking. The same dyke can be seen cropping out in the railway cutting near the road bridge over the railway at the new deviation of the line.

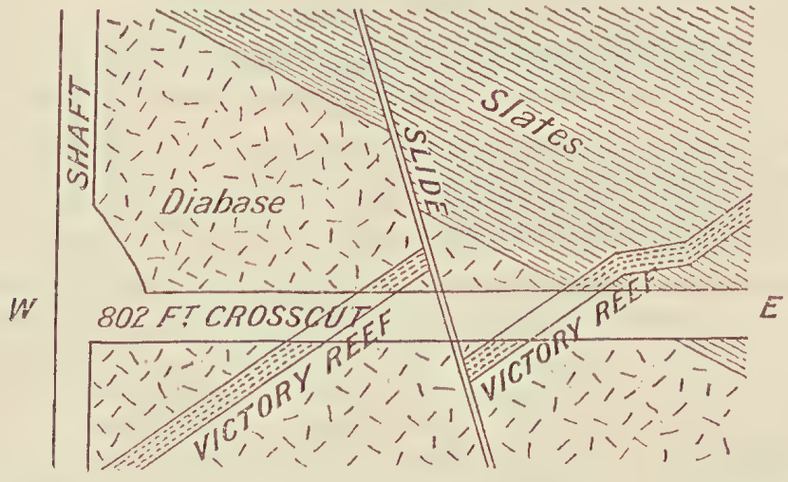
I have not the particulars of the strata passed through below the diorite dyke.

A crosscut has been driven to the east at the 802-feet level. At 40 feet east of the shaft the Victory Reef was met with; it was 4 feet in width, and was in an altered green diabase. A patch of gold was got in the centre of the reef as the crosscut was driven through it.

The crosscut was continued, and met with a fault (locally termed a "slide"), dipping steeply to the east, and at 78 feet east of the shaft the Victory Reef was again cut on the eastern side of the slide.

The following sketch, Fig. 4, explains the way in which the reef and the slates have been faulted by the slide:—

Fig. 4.



Sketch Section, showing Faulting of the Victory Reef and Slates at the 802-feet level.

In the crosscut at 78 feet from the shaft the reef was 15 inches wide. Drives were put in both to the north and south.

The south level has been driven for a distance of about 330 feet south of the crosscut. The reef is very flat, and in one part almost horizontal for a short distance.

In the stopes above the level the reef various from a few inches up to 2 feet 6 inches in places, and it is in good slate country. The reef shows gold throughout, which in places has been very rich, two crushings lately of 406 tons have yielded no less than 1,906 oz. of gold.

At about 300 feet south of the crosscut a cross-course was met with which threw the reef to the west; there was a large body of quartz where the reef was picked up to the north.

At 633 feet in depth a crosscut, 330 feet in length, has been driven in a westerly direction in good slate country. At 285 feet along this crosscut a formation consisting of 6 inches of quartz leaders was met with; and at 307 feet 2 inches of quartz.

The following are the crushings and amounts paid in dividends from this mine :—

	Tons cwt.	Oz. dwt.	Dividends.
1900	2,091 0 ...	2,354 13 ...	£3,600
1901 (to end of June) ...	688 13 ...	1,718 0 ...	3,000
	2,779 13	4,072 13	£6,606

THE TWO-MILE GOLD MINES (Lease No. 1220).

The area of this lease is 50 acres, and it is situated to the east of the Maryborough Road.

A portion of this ground was first worked by the Gympie Golden Crown Company, and was described by me in 1891* as follows :—

"*The Gympie Golden Crown, Two-Mile.*"—Three shafts have been sunk on this ground. The main shaft is down 233 feet. The following is a section of the strata passed through :—

Soil and decomposed surface rock	From surface	to	15 feet
Altered boulder conglomerate...	„ 15 feet	„	33 „
Sandy shale	„ 33 „	„	39 „
Altered boulder conglomerate...	„ 39 „	„	152 „
Black shale (rich in pyrites)	„ 152 „	„	156 „
Altered greenish boulder conglomerate	„ 156 „	„	192 „
Altered grey grit	„ 192 „	„	210 „
Fine altered sandstone	„ 210 „	„	233 „

At 210 feet in depth a crosscut has been driven in a direction east 20 degrees north. The Peter and Paul Reef was cut at a distance of 100 feet from the shaft. A "rise" has been put up on this reef, and 30 feet above the crosscut the slate was met with. The reef, which is about 1 foot in width, breaks back 4 feet on a good slate "break." The reef is bearing a little west of north. Good gold-bearing quartz is being obtained along the "break." There has been no crushing from this reef as yet. The drives along the reef, north and south, are about 100 feet in length.

A small leader was passed through in the shaft, underlying to the east; this was met with in the crosscut at 12 feet east of the shaft. The grey grit occurs in the shaft as far as this leader, and then an altered pebbly conglomerate. At the end of the crosscut the same fault is met with that occurs in the western crosscut of the No. 1 North Phœnix Claim.

This crosscut has been driven for some distance beyond the point where the John Bright Reef, which is a large reef on the surface, should have been cut, but there has been no sign of it.

The western shaft is just 200 feet west 12 degrees south of the main shaft. It is 186 feet in depth. The rock for the most part was altered conglomerate, the section being very similar to that of the main shaft. This shaft was sunk on the All Serene Reef all the way down. The reef is well defined, and averaged 3 feet in width It bears north 19 degrees west. The level of the ground at this shaft is 12 feet above that of the main shaft. No. gold was seen in the reef. The thin bed of slate which occurs in the main shaft at 152 feet was not seen in this shaft, though this was probably owing to the shaft being sunk on the reef. This slate should occur at a depth of from 140 to 145 feet.

The eastern shaft is situated 340 feet north 26 degrees 5 minutes east of the main shaft. It passed through—

Coarse boulder conglomerate from surface to 100 feet.
Black graphitic shale full of pyrites, from 100 to 103 feet.
Coarse pebbly conglomerate, from 103 to 142 feet.

Crosscuts had been driven east and west for a distance of 33 feet each way, at the 130-feet level. No reef had then been cut. The shaft is situated between the Peter and Paul Reef, the outcrops of which are 122 feet apart at the surface. I understand that the Peter and Paul Reef has since been met with in the western crosscut; but the John Bright Reef has not been seen, although the eastern crosscut has gone some distance beyond the point at which it should have been met with. The latter reef, though big at the surface, does not appear to "live" going down.

The shafts in this claim have not gone down deep enough to reach the thick bed of slate met with in the adjoining No. 1 North Phœnix Claim."

The work was abandoned without sinking the shaft deep enough to cut the deeper slate.

Last year the present no-liability company was formed to test the deeper ground, and the shaft was sunk to a depth of 670 feet.

I have not the full particulars of what was passed through in the shaft. The top of the slate was cut at 435 feet in depth, and good slate passed through down to 455 feet. Then came grey sandstones and shales with good plumbago floors at 470 feet and 493 feet in depth. At 600 feet there was 3 feet of black rock, and in the bottom of the shaft at 660 feet there was 7 feet of black rock and slate.

At 474 feet a crosscut was put in to the east, and the Peter and Paul Reef was met with at 50 feet from the shaft, showing only about 2 inches in width of quartz. After driving a short distance to the north, a "rise" was put up 43 feet. There was about 20 feet of slate country in this "rise," but unfortunately the reef had pinched out, and the workings at this level were abandoned.

At 424 feet a crosscut was driven in a direction west 10 degrees south for the All Serene Reef which crops out a little over 200 feet west of the shaft.

At the surface the All Serene is a big reef, and some work was done on it some years ago.

At the shaft and for 42 feet along the crosscut the country consists of a dark-coloured sandstone which is carbonaceous and contains a large quantity of iron pyrites.

At 42 feet in there is a nice plumbago slate floor carrying pyrites; below this are alternate black slates and sandstones, and then two more good slate floors, 8 feet apart, separated by a chloritic shale; below that again is a hard sandstone.

At 178 feet along the crosscut there is 2 feet in thickness of soft plumbago shale.

At 202 feet from the shaft the All Serene Reef was cut in the roof of the crosscut. There was 15 inches in width of quartz, which comes down on to a "break," and, although the crosscut was driven a further distance of 26 feet, the reef below the "break" was not met with. No gold was seen.

---

* "Second Report on the Gympie Gold Field" by William H. Rands, Assistant Government Geologist. Brisbane. By Authority: 1891.

A drive was started on the reef in a northerly direction, and is in 27 feet, but there is still no gold showing. A rise has been put on the reef to 16 feet above the crosscut. There is 6 inches of quartz at the top of the "rise," but no gold is showing, although there are some splendid plumbago shale floors, carrying pyrites. The reef here is bent over, and underlies slightly to the east, but it appears as though it is turning back to the usual western underlie, though this reef has a very slight underlie at all.

The country is all that could be desired, but still the reef carries no gold. I am of opinion that the drive and "rise" should be proceeded with, and afterwards a winze sunk from the northern end of the drive to the bottom of the slate country.

From the record of the shaft I am very doubtful whether the bottom of the slate country has been reached.

APPENDIX I.

Table showing the annual yield of gold of the Gympie Gold Field from its commencement in 1867 to the end of June, 1901:—

Year.	Oz.	Year.	Oz.
1867 to end of 1876 ...	581,146	1890	78,366
1877	43,854	1891	60,714
1878	41,564	1892	82,939
1879	38,453	1893	78,978
1880	43,072	1894	111,168
1881	67,861	1895	78,026
1882	50,312	1896	73,729
1883	64,818	1897	96,251
1884	112,051	1898	106,302
1885	89,600	1899	89,772
1886	88,600	1900	93,522
1887	102,149	1901 (to end of June) ...	44,565
1888	107,119		
1889	115,590	Total	2,540,521

APPENDIX II.

PETROLOGICAL NOTES.

ROCK FROM THE SHAFT OF THE No. 3 SOUTH GREAT EASTERN, BETWEEN THE DEPTHS OF 600 AND 900 FEET.

An eruptive rock, probably altered diabase. The rock is highly altered, and not well preserved. It has a great resemblance to the diabases described below. Crushing is apparent.

The base is indistinctly microcrystalline, with scattered phenocrysts of felspar.

Plagioclase Felspar.—All altered into kaolin, calcite, &c., but still in some cases showing twinning. The smaller laths are oriented about the larger crystals to a slight extent.

Magnetite developed abundantly, giving the base a prevalent dark tint.

Epidote.—Present as a few scattered grains. The original ferro-magnesian constituent is not recognisable.

ROCK FROM THE SHAFT OF THE No. 3 SOUTH GREAT EASTERN, BETWEEN THE DEPTHS OF 900 AND 950 FEET.

This rock has a schistose character, and is too altered to be determined with certainty. It is an eruptive rock, probably a tuff.

The base is fine microcrystalline, with phenocrysts and amygdaloids.

Plagioclase Felspar.—Twinning is seen in few of the larger crystals, but both large and small are greatly altered.

Epidote occurs throughout the base.

A green clouded serpentinous mineral is plentiful.

Haematite.—Due to the alteration of magnetite, is abundant, both as large fragments and as stains in the base.

Magnetite is abundant; sometimes as skeleton crystals.

Calcite (*secondary*) very abundant.

Quartz (*secondary*) in small quantities.

ROCK FROM THE SHAFT OF THE No. 3 SOUTH GREAT EASTERN, BETWEEN THE DEPTHS OF 950 AND 990 FEET.

This is a tuff.

The rock is very fine-grained, and much altered.

Base is cryptocrystalline, containing angular fragments of an altered zeolite (?), viridite, felspar, and quartz, the latter also occurring in rounded forms.

Secondary quartz and calcite are present.

Epidote.

Magnetite.—A few grains.

ROCK FROM THE SHAFT OF THE No. 3 SOUTH GREAT EASTERN, BETWEEN THE DEPTHS OF 900 FEET TO BOTTOM.

This is an eruptive rock, probably an altered diabase.

The base is cryptocrystalline, and contains small meshed felspar crystals, very much altered, but arranged in flow structure.

Fayalite.—As large phenocrysts, usually well formed, with fractures marked by secondary magnetite and hematite. The mineral is replaced in parts by epidote.

Large granules of some mineral completely altered into calcite.

Kaolin.—Present in some quantity.

Epidote and Magnetite are plentiful in the base.

Rock from the Shaft of the No. 1 South Gympie Gold Mines from a Depth of 1,450 Feet to the Bottom.

The rock is olivine diabase. It is amygdaloidal in parts, and is much altered.
The base is microcrystalline, with large meshed crystals of fel-par.
Felspar.—As laths. One or two of the crystals have the single twinning of Orthoclase, but most of them show the twinning of Plagioclase, even though altered into calcite, kaolin, and quartz, &c.
Magnetite occurs in irregular grains, some of which are altered into hematite.
Augite occurs as large-zoned octagonal crystals, somewhat altered.
Fayalite.—There is one large crystal altering into magnetite and hematite.
Epidote.—In irregular and fan-shaped masses, lining cracks.
Serpentinous stains occur throughout the base.

Rock from Crosscut at the 1,426 feet Level of the No. 1 South Gympie Gold Mines, 75 feet North-west of the Shaft.

An altered tuff, though it may be an altered eruptive rock. It is more siliceous than the tuffs above described.
The base is cryptocrystalline to microcrystalline.
Quartz plentiful as angular and rounded grains, which often fade into the ground mass. Secondary quartz occurs.
Calcite.—Abundant as veins, and impregnating the ground-mass.
Pyrites.—Fairly large crystals and fragments.
Serpentinous mineral abundant.

Rock from the Crosscut at 1,424-feet Level, in the Scottish Gympie Gold Mines, 350 feet North-west of the Shaft of the No. 1 South Gympie Gold Mines Shaft.

An eruptive rock, probably an altered diabase, but it might be a crushed and altered breccia, made up of fine fragments of an eruptive rock. The rock is much altered and crushed.
The base is very fine, and has a schistose structure.
Felspar is much altered. Laths are visible in the portion least crushed.
A Serpentinous mineral is plentiful as green stains, fibrous in places.
Limonite filling the lines of crushing.
Secondary Quartz filling some of the cross fractures.
Calcite filling the larger cross fractures.
Hematite occurs in the calcite of the veins.

Rock from the Crosscut through the Inglewood in No. 2 South Great Eastern at the 1,420-feet Level.

The rock is a diorite.
The rock is somewhat altered, but nothing like so much as those above described.
The Base consists of completely meshed felspar laths of comparatively large size.
Plagioclase Felspar.—The crystals are mostly altered.
Orthoclase Felspar is not so plentiful as the plagioclase, but it is also altered.
Hornblende filling the spaces between the felspar; the laths are filled with a greenish secondary mineral. There are a few indistinct crystals showing the cleavages and faces of hornblende.
Quartz occurs in small quantity, probably derived from the felspar.
Secondary Calcite occurring in veins.

Rock from the Inglewood Dyke at the 770-feet Level of the No. 2 South Great Eastern.

The rock is a diorite. It is somewhat altered, and is very similar to that just described.
The base is microcrystalline.
Plagioclase Felspar.—Chiefly altered into kaolin, with borders of silica.
Magnetite occurs in some quantity.
Hornblende.—The cleavage can be seen in a few places in the serpentinous mineral into which it has been altered.
Secondary Calcite is plentiful.

Rock from the 990-feet Crosscut above the Slate at No. 3 Reef in the South Glanmire and Monkland.

The rock is a tuff, or possibly a completely altered eruptive rock. It is very much altered, and entirely different to any rock described.
The rock shows a Mosaic of the following minerals:—Epidote, calcite, quartz, kaolin, felspar, spherulitic zeolite.

Rock from Mullock Heap of the Old Dawn Mine.

The rock is a diabase, rather altered.
The base is microcrystalline with felspar laths and phenocrysts of plagioclase, augite, olivine, and magnetite.
Plagioclase Felspar occurs both as laths and phenocrysts.
Augite in fairly large unaltered crystals and grains.
Olivine occurs altered into magnetite and serpentine.
Magnetite in coarse grains, some of which are secondary.
Epidote occurs in fair quantity.
Secondary Quartz in small quantity.

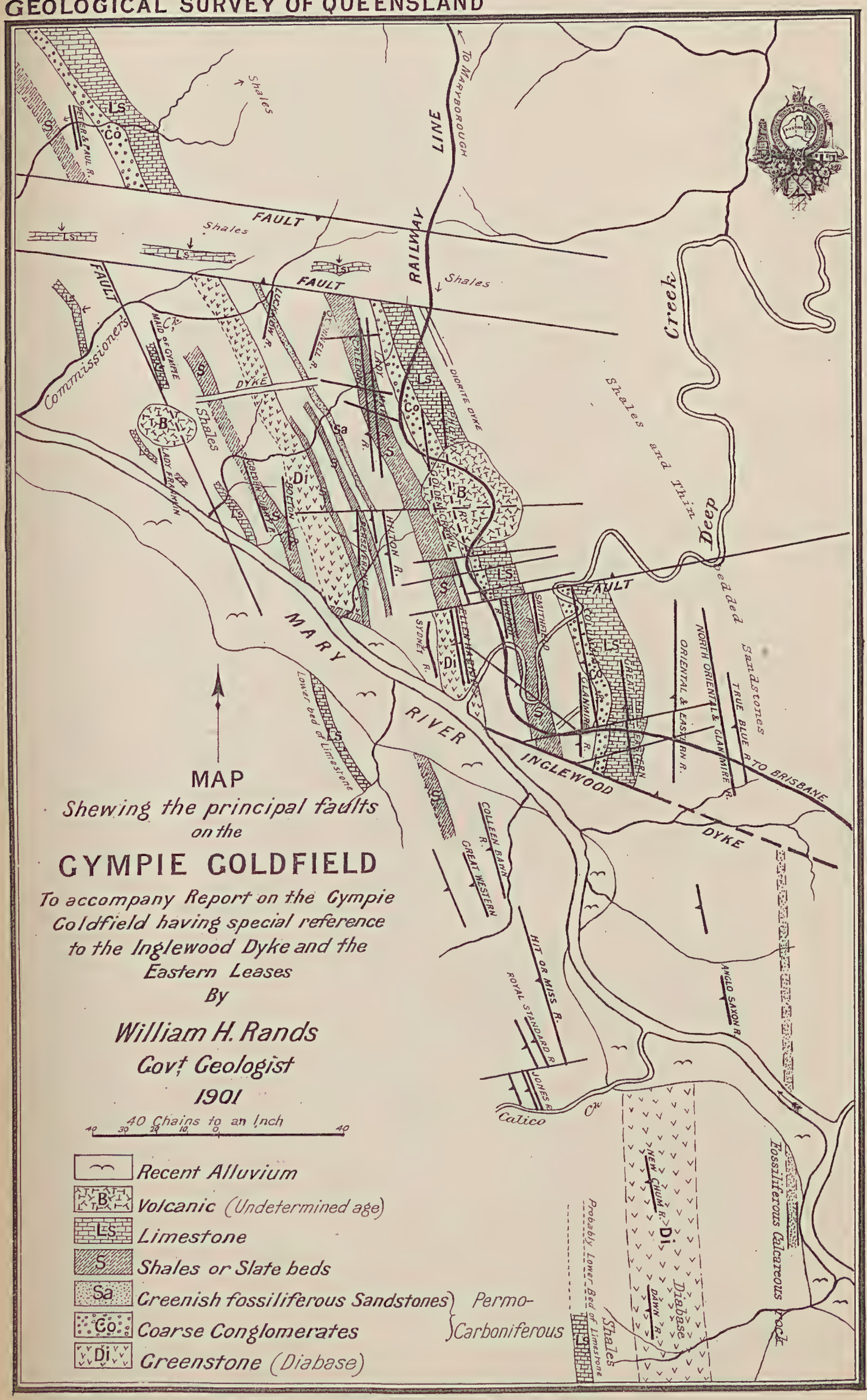
Rock from the Dyke in the Shaft of the West of Scotland at a depth of 1,090 feet.

The rock belongs to the diorite group.
The base is microcrystalline, and consists of felspar, quartz, a decomposed ferro-magnesian mineral, and oxide of iron.
Felspar in long lath-shaped crystals, much decomposed. Inclusions numerous, but the section is too thick to allow of determination. The chief product of decomposition is calcite.
Quartz.—Secondary filling in the interstices between the felspars.
Ferro-magnesian Mineral occurs in irregular patches, and is altered into serpentinous matter. All structure of the previous mineral has disappeared.
Hematite occurs in angular and irregular grains, and is an alteration of the original magnetite.

[No. 166 of the Geological Survey Publications.]

Price 11*d.*]

By Authority: George Arthur Vaughan, Acting Government Printer, William street, Brisbane.



MAP

Shewing the principal faults on the

GYMPIE GOLDFIELD

To accompany Report on the Gympie Goldfield having special reference to the Inglewood Dyke and the Eastern Leases

By

William H. Rands
Govt Geologist

1901

40 Chains to an Inch

40 30 20 10 0 40

- Recent Alluvium
- B — Volcanic (Undetermined age)
- LS — Limestone
- S — Shales or Slate beds
- Sa — Greenish fossiliferous Sandstones } Permo-
- Co — Coarse Conglomerates } Carboniferous
- Di — Greenstone (Diabase)

NATIONAL MUSEUM
VICTORIA

VICTORIA.

1901.

QUEENSLAND.

THE KANGAROO HILLS MINERAL FIELD.

(REPORT ON, BY WALTER E. CAMERON, B.A., ASSISTANT GOVERNMENT GEOLOGIST)

[*With 1 Map and 9 Plates.*]

Presented to both Houses of Parliament by Command.

THE HONOURABLE THE MINISTER FOR MINES.

Geological Survey Office,
Brisbane, 24th October, 1901.

SIR,—I have the honour to forward herewith a Report on the Kangaroo Hills Mineral Field, with one map and nine plates, by Walter E. Cameron, Assistant Government Geologist.

I have, &c.,
WILLIAM H. RANDS,
Government Geologist.

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I.—INTRODUCTION.

The Kangaroo Hills Mineral Field lies in country drained by Oaky Creek and the Running River, tributaries of the Burdekin. These streams rise on the south-western slopes of the coast range, which forms the background to the flat alluvial sugar lands at the mouth of the Herbert River. Their sources are some 6 or 7 miles apart, and they flow south-westerly to join the Burdekin, some 25 miles lower down, their junctions with that river being only some half-a-mile apart. The mineral field covers an area of about 30 miles in length by 12 miles in breadth. The local sketch attached to the accompanying geological map of the field shows its position relative to the coast and the coast range. The map shows the topography of the field as accurately as it is known at present without detailed surveys.

The prospecting, in 1892, of the old silver and tin lodes lying between the Running River and Oaky Creek near their junctions with the Burdekin, and the formation of the Running River Mining Company, led to the surveying of a township at Ewan. This township is now represented by two houses, owing to the failure to sell the mines to a southern company and their consequent abandonment. The recent discovery of lode tin a few miles further north, on Oaky Creek, and the formation of the Waverly and other tin-mining companies, has led to the opening of a post office at Kallanda, some 8 miles due north of Ewan, and the reserving of an area for a township of that name.

The coast range forms the boundary of the mineral country on the north-east. It presents an abrupt front to the sea at a distance of from 8 to 30 miles from it, and has a general elevation of nearly 2,000 feet above it. It is at present impracticable for vehicles wherever it is approached from the mouth of the Herbert River, and all conveyance to the field from the coast at this point has to be undertaken by means of horses. There is a fall from the summit of the range to the Burdekin of about

1,000 feet. As in ordinary seasons there is a good rainfall on the range, the main streams are generally kept well supplied with a permanent flow of water. The country from the range to within a few miles of the Burdekin is rough and hilly, and this fact combined with the abruptness of the range front has formed one of the chief difficulties to be overcome in the opening up of the field owing to the difficulties and expense of finding passable roads. At present all material that cannot be packed on horseback comes by team from Townsville, crossing the range at Thornton's Gap—a difficult pass over the range some 40 miles south of the track over the Herbert River. This road, after passing Thornton's Gap and the Argentine, crosses the Burdekin at the Continong, and again higher up at its junction with Oaky Creek, the latter crossing being about 100 miles from Townsville. It then reaches Kallanda and the tin mines by a circuitous journey of some 35 miles. A much shorter road could be found from the Burdekin *viâ* Ewan, the Douglas Mine, and the Waverley Battery up Oaky Creek were it not for the abrupt banks of the creek between the two latter places. The construction of a road between these two places would involve about a mile of expensive cutting and forming along the left bank of Oaky Creek.

The Ingham Divisional Board tramline up the Herbert River runs from Lucinda Point near the mouth of the river to the foot of the range at the head of the Stone, a branch of the Herbert, a distance of about 35 miles. From the head of the Stone a road has been surveyed to the crest of the range by Mr. Callendar, C.E., which rises 1,752 feet in 2 miles 57·9 chains, giving an average ascent of 1 in 8·2. From the top of the range at this point to the Waverly Battery is about 18 miles over a good road; and to Ewan, *viâ* the Douglas Mine, another 6 miles, making about 21 miles from the battery, and about 27 from Ewan to the head of the Stone and the tramline terminus. If, therefore, a practicable road could be found over the range at the head of the Stone, the road distance from the Waverly Battery to easy communication with a port would be shortened from 130 miles to about 20; and if in addition a good road could be constructed from the Waverly Battery, past the Douglas Mine, along Oaky Creek, the tin mines near Kallanda would have easy access to the well-grassed country of the Burdekin, and the distance from Ewan to communication with a port would be shortened by about 80 miles.

The construction of a road up the range behind Ingham has been reported on by three engineers. That surveyed by Mr. Callendar, B.E., as mentioned before, rises 1,752 feet in 2¾ miles, and involves very steep grades over almost the whole of the way, the average for the last mile and 10 chains being 1 in 4·6. These can hardly be considered suitable grades for wheel traffic, notwithstanding the fact that the grades over Thornton's Gap, as found by Mr. Greensill, L.S., are almost as steep. Mr. Greensill found the following grades on the road over Thornton's Gap:—

1 in 6 for 9 chains
1 in 4 for 7 „
1 in 5 for 4 „
1 in 4 for 4 „
1 in 3½ for 4 „

This road over Thornton's Gap was the main road to the Etheridge and Gilbert Gold Field for many years, and over it most of the heavy machinery for the mines at Goldsmith's Creek, Castleton, and Charleston was conveyed. It is still the most direct road from the eastern seaboard to the Gilbert, Einasleigh, and Upper Burdekin Rivers, and in default of any better road is still in constant use by teamsters. As Mr. Greensill points out, however, in his report, the steep pinches over the gap are only surmounted by double-banking and frequent resting of teams.

Mr. Adams, C.E., in his report claims to have found a spur leading up to the crest of the range behind Ingham, between the two branches of the Stone River, which would give a road with grades of from 1 in 15 to 1 in 10, and estimates the cost at about £5,000. The Ingham Divisional Board do not feel justified in spending that amount of money on road-making. As to whether it would pay them to spend between £2,000 and £3,000 in building the cheaper road surveyed by Mr. Callendar, and by so doing bring freight to this tramline, it must be remembered that the prospects of the mines turning out regular producers are as yet hardly sufficiently firmly established to warrant any very great increase of traffic being counted on, as the output would need to be considerably larger and more regular before such a road could be expected to pay for itself in freight brought to the tramline, even if the heavy grades were found suitable for wheel traffic.

Below are the yearly returns of dressed tin ore despatched from the Kangaroo Hills Field since the year 1895, as given in the Annual Reports of the Department of Mines, together with the return for the first three quarters of 1901:—

Year.	Tons	cwt.	Value. £	s.	d.
1895	55	10	1,665	0	0
1896	43	0	1,080	0	0
1897	19	0	570	0	0
1898	10	0	250	0	0
1899	22	0	1,203	0	0
1900	61	0	4,555	0	0
1901 First quarter	34	19	2,220	10	0
1901 Second quarter	57	16	3,656	0	0
1901 Third quarter	31	3	1,869	0	0

II.—GEOLOGY.

The Kangaroo Hills Field covers an area occupied by altered sedimentary rocks and granite. The former occur in a belt extending along the lower valleys of the Running River and Oaky Creek as far as their junctions with the Burdekin. They are surrounded by granite on all sides, except on the west, where a newer series of sedimentary rocks overlies both them and the granite on the western side of the Burdekin River. The accompanying map shows approximately the boundaries of the granite and older

sedimentary rocks. The boundaries are only roughly sketched, the topography of the district being very imperfect. Numerous smaller patches of the older sedimentary rocks are found in the granite east of where the boundary line is drawn. Dr. Jack reported on the lodes of the Kangaroo Hills Silver Field in 1892*, and thus describes the character of these sedimentary rocks:—

"The country rock of the whole of the mining district (as then being exploited) consists of alternations of mica schists, talc-schists, greywacke, grits, conglomerates, quartzite, and limestones. The schists and quartzites are frequently interspersed with minute garnets, which are at times so numerous that for practical purposes I have designated them 'garnet rock.' The whole of these rocks are highly inclined, frequently vertical, and so much broken up by faults, that it is impossible to trace any individual bed for more than a few chains. Beds of limestone are met with along the south-west and north-east belt of mineralised country already referred to in a previous paragraph as well as among the Mount Brown Group of Mines. As these limestones have been described by various writers as having been traced for many miles, I have laid them down on the map (accompanying the report) wherever they are visible, and it will be seen that not one of them is traceable for any distance. On the contrary the outcrops of the limestone not only prove that they, as well as 'the adjacent sedimentary rocks,' have been tilted up, contorted, and literally chopped up into pieces by faults, but also that the limestones themselves were originally isolated deposits, probably coal reefs.

"The limestone beds vary considerably in character, but all have suffered a great amount of alteration. The prevailing type is a white crystalline or saccharine marble. It is generally free of silica, but, on the other hand, some beds, having originally been charged with siliceous sand, now present little more than a skeleton of silica, the calcareous portions having yielded more to denudation. Sometimes, in the comparatively pure limestone or marble, the segregation of siliceous matter has formed a network of veins. In a limestone so highly metamorphosed it is not surprising that distinguishable organic remains are sought for in vain. I have indeed seen a few fossils which could be recognised as corals, although but slight traces of their outlines or structures were preserved.

"The age of the stratified rocks must for the present remain an unsettled question. Mr. Maitland doubtfully refers them to the 'Burdekin Bed' (Middle Devonian), believing them to be continuous with them, as they are developed lower down the Burdekin Valley, where they afford an abundance of characteristic fossils, as well as to be similar in lithological character. But it must be confessed that there is little evidence either for or against this view.

"The stratified rocks are pierced by masses, of limited extent, of intrusive acidic 'felstone' or felspar-and-quartz porphyry, a rock composed of orthoclase felspar with blebs of quartz."

Wherever the boundary between the granite and sedimentary rocks is well exposed, the intrusive nature of the granite, and consequently its later age, is made clear. A good example of this is seen on the left bank of the Running River, on the track between Ewan and the Macaulay Creek Mines. At this point a gully coming out from the granite hills exposes the upturned quartzites of the sedimentary beds in contact with the granite, with tongues of the latter passing into them. The sedimentary beds are thus seen to be older than the granite, but further than this no evidence was forthcoming as to their stratigraphical position. The granite is perfectly normal in character, being composed for the most part of pink or white orthoclase with quartz and biotite mica. Intrusive dykes of diorite and also of eurite were observed at Macaulay Creek and Hidden Valley.

III.—PROGRESS OF MINING DEVELOPMENT.

Practically no work has been done on the lodes near Ewan described by Dr. Jack since the time of his visits. The only exception is a little development on the True Blue Lode. Alluvial tin was discovered some years ago by the first prospectors for that metal in the district, Messrs. Naven and Regner, at the junction of Prospectors and Sandy Creeks. Since then some tons of stream tin have been sent away. Of late years the profitable working, by windlass and dolly, of rich shoots of lode tin, some 12 miles further down the creek, on the Rob Roy Lode, has led to more systematic prospecting for lodes of that mineral. Several companies have been formed with the object of acquiring tin lodes and mining and dressing the ore on a large scale. Of these the Waverley Tin Mines, Limited, has erected a 10-head battery on Oaky Creek, with rock-breakers, mills, jigs, Wilfley tables, Frue vanners, and buddles, capable of treating 300 tons of ore a week. The Planet, Douglas, Kangaroo Hills, and other groups of properties, although they have in some cases raised a considerable quantity of ore, are at present for the most part doing little mining, awaiting the raising of capital to begin systematic work. At Mount Benham, near the source of the Running River, a small 3-head Park and Lacy prospecting battery has been erected by a party of working miners who have opened up a few small lodes in that locality.

The discovery of copper-ore of good percentage and high silver value in the True Blue Lode and Mount Thekla Mine at Ewan, and at Macaulay Creek, have turned attention to that mineral, and hold out good prospects of an attempt to smelt the ores on the ground. Messrs. Lennox and Rannie estimate that they have raised, at the True Blue Mine, 70 tons of ore, estimated to carry 20 per cent. of copper and 60 oz. of silver to the ton, and about 300 tons of seconds, estimated to carry from 12 per cent. to 14 per cent. of copper and 25 to 30 oz. of silver per ton; and at the Mount Thekla Mine about 200 tons of ore which they were then bagging for cartage to the smelting works. At the Macaulay Creek Mine, Mr. Alex. Harper estimates that he has raised over 1,000 tons of copper and silver ore which will pay for smelting on the spot.

IV.—TIN MINING.

All the tin lodes at present being worked occur in granite country. The two main centres of prospecting are:—Firstly, the lodes in the neighbourhood of the proposed township of Kallanda, about 12 miles up Oaky Creek from the Burdekin River; and, secondly, the lodes in the ranges at the sources of the Running River. The former comprise the properties of the Waverley, Planet, Kangaroo Hills, and

* The Kangaroo Hills Silver and Tin Mines, by R.L.J. Brisbane: By Authority, 1892.

Douglas Tin Mining Company, with various minor shows. The latter are still held by parties of working miners, having not yet reached the company stage. On one lode only has machinery as yet been employed, none of the workings being over 100 feet in depth.

The Waverley Leases.

The majority of the leases taken up by this company are grouped together within a distance of a mile or so from the right bank of Oaky Creek. The Rob Roy and Red Gauntlet Leases are about a mile further west, and the Monastery and Lammermoor Leases about the same distance to the north-west and north respectively. The bulk of the work has been done on the Guy Mannering Lease.

Appended is a plan (Plate I.) of the work done, kindly furnished me by Mr. Dunn, the manager. The lease is intersected by a gully down which the road to the battery runs. The lode which strikes east and west crosses the road and gully at right angles. On the western side of the road the lode has been exposed as a face of about 6 feet of chloritic material standing vertically between granite walls. No. 2 Tunnel has been driven westerly from the level of the road along this lode, as shown on the plan, for a distance of about 76 feet. At this point the lode cut out on a granite floor. Five feet from the end of the tunnel crosscuts have been driven N. 30° W. for 41 feet, and South for 11 feet, but failed to pick up the lode. At 38 feet, in a rise from the tunnel to the surface is in good ore, which is being stoped on a face of about 6 feet, and is estimated by Mr. Dunn, from previous crushings, to carry 5 per cent. of tin. No. 2 Shaft, 90 feet further west, is 26 feet in depth, and shows at the bottom 18 inches of chloritic lode estimated to carry 18 per cent. of tin. Cundy's Shaft, 30 feet further west, is 75 feet deep, and as the surface here is 75 feet from the tunnel level the bottom of the shaft is on a level with the tunnel. The bottom was full of water, and inaccessible. At 25 feet the lode passes out of the shaft to the north, and has been broken into by a crosscut, which shows about 2 feet 6 inches of lode estimated to go about 22 per cent. of tin. Judging from these exposures, this lode is exceedingly irregular and hard to follow. The ore body exposed in the No. 2 Shaft should be followed down to the tunnel level, and then driven on towards the tunnel. The position of the lode lost in the tunnel would thus be determined, and any shoots of ore between the shaft and the tunnel picked up. Driving on the lode to the west from the shaft at the same level could then be commenced if the results in the easterly driving from No. 2 Shaft warranted it.

On the eastern side of the road the lode has been opened up by a tunnel (No. 2) on the same level as No. 1, but driven at right angles to the lode from a point 129 feet to the south, as shown in the plan. The lode has then been driven on both east and west for 120 feet from this point. Mr. Dunn informs me that no ore of any consequence was found in the eastern drive. In the western a strong lode was followed all the way, but the ore was poor. The No. 2 Tunnel cut a parallel lode at 60 feet from the entrance which has been followed by a drive (No. 1A level west) going in 60 feet. The ore was poor, but a cross vein of ore occurred at about 20 feet along the level which, on being driven on, led to another parallel lode. This was "risen on" to the surface, and a considerable amount of ore stoped out to the east of the rise to the surface. The plan shows the position of these stopes. The tunnel has been continued across the country for a distance of 160 feet past the main lode. At 90 feet a small vein of ore was driven on for 35 feet to the west, but nothing else of any significance appears to have been met with. Judging from the character of the work done on this lode and the exposures that can at present be seen, it is patchy in character though rich in places. The runs of ore are difficult to follow, and have led to the prosecution of a considerable amount of dead work without as satisfactory results as were expected. This is evidenced by the comparatively small amount of ore that has been obtained for the relatively large amount of work done. Up to the time of my visit the battery had crushed 980 tons of ore for 49 tons 1 cwt. of black tin running about 65 per cent. metal. This gives a value for the ore treated of about £3 8s. per ton, with tin at 21s. per unit. A great portion of this ore I understand came from the Guy Mannering Lease, though a considerable portion was collected from material raised from other shafts before the present company took over the property. The value of the ore crushed from all sources has been under £3,500 for a considerable amount of development work. The work on the western side of the road appears to have exposed the best ore, and is certainly worth further development.

The Guy Mannering Lease was the only one on which work was being done at the time of my visit. The Magazine Shaft and Whiting's Shaft, on the *Ivanhoe Lease*, were inaccessible, so that I could see nothing of the workings there. On the *Rob Roy Lease* is the lode originally worked by the prospectors. The workings here were also inaccessible. The prospectors' shaft on this lode followed down a shoot of tin dipping to the west in an east and west vein. A block of ore about 80 feet in depth and from 30 feet to 40 feet in length has been stoped out on this shoot. The ore is said to have been rich ruby tin-ore in chlorite. A second shaft about 18 feet to the south-east of the prospectors' shaft is about 75 feet in depth, and crosscuts from the bottom have been driven 48 feet north and 30 feet south. Short levels were then driven east and west from the ends of these crosscuts, apparently on ore veins; but no stoping appears to have been done.

The Aberfoyle Shaft, on the same lease, is about 80 feet due north of these two latter. It is 65 feet deep on a wide but poor lode striking east and west and dipping to the north. No stoping appears to have been done. I could obtain no reliable information as to the value of the ore obtained from these workings. Apparently the ore was rich in places, but patchy, and though it paid the prospectors to follow the shoots down for some distance, as soon as haulage became too arduous they were abandoned.

The Planet Group of Leases.

The accompanying map shows roughly the position of the ground taken up by this company. Mr. Dunn, Manager for the Waverley Company, kindly accompanied me over the ground, in the absence of the Planet Company's Manager, and gave me all the information he could. The information is, therefore, all second-hand. No work was being done at the time of my visit, and most of the shafts were inaccessible.

On the Jupiter Lease, the *Jupiter Shaft* is 85 feet in depth on an east and west lode. The shaft was inaccessible. A heap of ore at the surface is estimated to go from 10 per cent. to 20 per cent. black tin.

The *Minerva Shaft*, which is 102 feet deep, is situated 3 chains from the northern boundary, and 2 chains from the eastern boundary of the lease; it is on a second lode, running east and west, well defined, and from 1 foot to 4 feet in width. Levels have been driven at the bottom 12 feet east and 35 feet west. The shaft was accessible to the water, about 60 feet, and showed a lode, with well-defined granite walls, 4 feet apart, underlying steeply to the north. The ore heap at the surface is estimated to bulk about 200 tons, and to carry about 5 per cent. of black tin.

On the northern boundary of the *Altair Lease*, a trench on the *Ladysmith Lode* running east and west, 6 feet deep and 50 feet long, exposes a chloritic lode running up to 3 feet in width. About 30 tons of ore, estimated to carry 5 per cent. black tin, are stacked. Four chains south a trench on the *Kimberley Lode* runs east and west for 165 feet. A shaft near the western end is 165 feet deep, but was inaccessible. The lode runs up to 4 feet in width. About 100 tons of ore have been raised, estimated to carry 5 per cent. of tin.

On the *Mars Lease* there is an open cut on the south-western corner of the lease on the side of the hill, and a pit about 14 feet deep. The lode is about 1 foot in thickness, between granite walls. About 12 tons of ore, estimated at 10 per cent., have been raised. A shaft on a second lode on the brow of a hill overlooking Oaky Creek is 72 feet deep with a level going west 32 feet along the lode to catch the dip of the shoot of ore. About 70 tons of ore, estimated to carry 10 per cent. of black tin, have been raised.

A pit sunk on a third lode called the *Lyddite Lode* is 6 feet deep, and shows about 2 feet 6 inches of chloritic lode matter with regular walls.

On the *Saturn Lease* are several trenches and shafts. The most easterly is a trench exposing a thin vein of lode material from which a few tons of ore have been raised. About 2½ chains further west is a shaft 20 feet deep on the same lode about 2 feet 6 inches wide. Further west a shaft 40 feet deep, and a trench 200 feet long, exposed a lode about 8 inches thick showing good tin in places. About 50 tons of ore, estimated to carry 5 per cent. black tin, are stacked. About 3 chains further west a shaft 45 feet deep, and a trench about 11 feet long, expose another lode about 2 feet wide, estimated to go 7 per cent. black tin. Several parallel veins are here opened out by surface trenching, on one of which is a second shaft 50 feet deep. On the *Satellite Lease* is a shaft 50 feet in depth connected at the bottom with a tunnel driven from a gully in an easterly direction along the lode. Payable tin was found at the bottom of the shaft and at the mouth of the tunnel, but the remainder of the tunnel was in barren lode material. About 100 tons of ore, estimated to carry 8 per cent. of black tin, have been raised.

It will be seen from the above details that a considerable amount of prospecting work has been done within a comparatively small area, and according to the figures given a considerable quantity of payable ore has been raised. The company are waiting for capital to further develop their lodes.

The Douglas Mine.

The Douglas Mine lies about a mile below the Waverly Battery, on Oaky Creek. Between the battery and the mine the creek runs through rough hilly country, and the nearest wheel road between the two makes a detour of some 35 miles round. It is estimated that a road could be made up the creek for about £1,800. This would bring the Waverly, Planet, and Kangaroo Hills Mines into easy communication with Ewan and the Burdekin country.

Plate IX. shows the work that has been done on the lode. It was idle at the time of my visit. The lode crops out on the side of a steep hill, which comes right down into the creek. It strikes east-south-east, and dips steeply to the north. A tunnel driven from the bank of the creek in a north-easterly direction cuts the lode in 148 feet, and a shaft from a point on the lode 38 feet vertically above the tunnel goes down on the lode and meets the tunnel. The plan shows the remainder of the work. The outcrop above the shaft has been broken down in a face 7 feet across of green chloritic lode material. The lode lies under a well-defined hanging-wall of granite to the north, but the footwall is not exposed. The first 4 feet under the hanging-wall is estimated to carry from 2½ to 3 per cent. tin, and the second 3 feet to carry about 12 per cent. of tin. The drive under the outcrop passed through good ore, but shows the richer band pinched in the face. About 60 tons of ore taken from the outcrop and the drive is stacked at the mouth of the tunnel, and is estimated to go about 12 per cent. of tin.

At the tunnel level the east drive goes along the hanging-wall, and the west drive along the footwall of a strong lode, which, however, does not carry payable tin over this portion. Mr. Lennox, one of the proprietors of the mine, accounts for this by supposing that the shoot of ore found on the surface above the shaft dips to the east, and that the east drive at the tunnel level is not in sufficiently far to catch the shoot. I have no doubt that his supposition is correct, and it could no doubt easily be tested by continuing either the second or tunnel level further to the east. The work in the shaft and western drive at the tunnel level should have shown whether the shoot dips to the west if it continues any distance below the mouth of the shaft.

The Kangaroo Hills Tin-mining Company's Freeholds, Nos. 166 and 198.

These freeholds lie in granite country north of Oaky Creek. They had afforded a considerable amount of alluvial tin to their original owners, the prospectors of the field, Messrs. Naven and Regner.

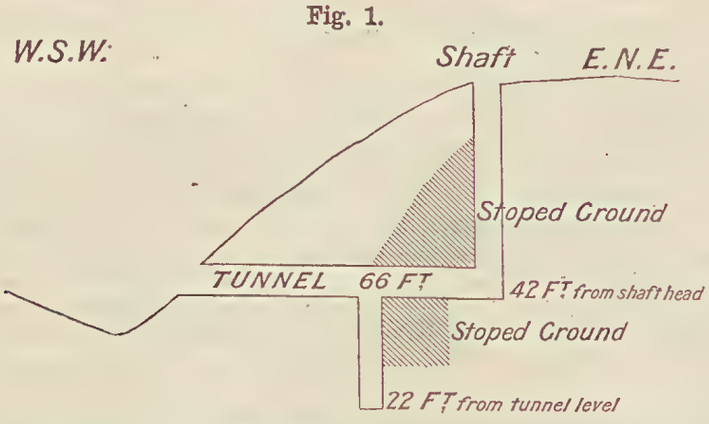
On *Freehold No. 166* two shafts have been sunk on what is apparently the same lode running east and west through the property. They were 55 feet and 58 feet deep respectively, and about 6 chains apart. Both had water in the bottom. At the eastern shaft, 55 feet in depth, about 120 tons of ore were stacked, showing good tin in quartz. At the western, 58 feet in depth, 5 tons of ore ready for bagging were stacked, and about 30 tons of much poorer stone. At the bottom of the shaft levels had been driven 40 feet east and 30 feet west along the lode, but they were inaccessible. The tin ore here occurs in a different manner to that generally found near Kallanda, being associated with narrow veins of quartz, being coarser in grain, and bearing a considerably greater ratio to the mass of the gangue stuff. The lodes, however, though rich in places, are apparently small and patchy.

On *Freehold No. 198* a shaft full of water and an open cut further west show coarse tin with quartz. Further west a tunnel into an outcrop on the side of the hill shows coarse tin associated with galena and copper pyrites, which is reported to occur in a large body in the end of the tunnel. The tunnel was inaccessible owing to flooding by surface water.

The Hidden Valley Lodes.

In the hills about the sources of the Running River several small tin lodes have been found, and a party of miners have erected a three-head Park and Lacy prospecting battery with hand buddle. For the months of February March, and April this battery crushed in all 70 tons of ore from various lodes for a return of 11 tons of black tin. The country rock is for the most part of granite, but patches of mica schist and sandstone occur, and intrusive dykes of diorite and of elvan were observed. Stone was being obtained from one lode only on the *Lord Roberts Lease* No. 93. This lode is vertical and strikes N. 65° E. The lode occurs as veins of quartz and chloritic material between well-defined granite walls, the tin occurring in streaks through the quartz. The lode runs up to 2 feet in thickness in places. The shoot is apparently a short one, some 20 feet long at the tunnel level, and dips steeply to the west. It has been opened up by a shaft 42 feet in depth, and a tunnel 66 feet in length, as shown in the accompanying figure. From the tunnel a winze has been sunk a further 22 feet on the shoot of ore.

Fig. 1.



Plan of Workings on the Lord Roberts Lease—Scale, 40 Feet to an Inch.

Thirty-one tons of stone have been obtained from this shoot of ore for a return of 5 tons 11 cwt. of black tin, of 65 per cent. metal, giving a value of £360 15s. with tin at £100 a ton. Heavy water has prevented further sinking on the lode. A second shoot of ore occurs about 80 feet east of that worked in this shaft. It has not as yet been opened up.

Several other small lodes have afforded small crushings, but none have been rich enough to encourage further work. On Lease No. 111 a large quartz lode or reef some 16 feet across occurs, which has been opened on a face on the side of a gully. A portion of this, about 4 feet in width on the northern side, is softer and more chloritic looking than the rest. A small trial crushing from this portion was being put through at the prospecting battery at the time of my visit. I have since been informed that it went 4 per cent. black tin.

At Mount Benham, on the crest of the range, good lodes are reported to have been found. These lodes had been abandoned for some time at the time of my visit to the field, awaiting the raising of capital to further develop them. As they were reported to be heavy with water, and so inaccessible, I did not visit them. Since that date a company, called the Mount Spec Tin-mining Company, has been formed to develop them.

V.—COPPER AND SILVER MINING.

Of late years, owing to the increased price of copper, a considerable amount of prospecting for this metal has been done in the district. The most important results of this work have been the developments at the Mount Thekla Mine, on Oaky Creek, about 8 miles up from its junction with the Burdekin, and at the Macaulay Creek Mines on Macaulay Creek, another tributary of the Burdekin, a few miles south of the Running River. The Old True Blue Lode, reported on by Dr. Jack, has also received some attention. The feature of the copper ores is the high percentage of silver they carry. A rough sample taken from the sulphide ore on the ore heap at the Mount Thekla Mine gave a return of 10 oz. of silver per unit of copper. The average monthly assays made by Mr. Harper, Manager of the Macaulay Creek Mines, taken from his record book kindly placed at my disposal, show returns of from 3 to 10 oz. of silver per unit of copper. A sample of copper glance, taken by myself from the ore heap of the Western Mine, one of the Macaulay Creek Group, gave a return of 38·75 per cent. copper and 120 oz. of silver per ton. Zinc also enters into some of the ores in considerable proportion, but hardly in sufficient degree to interfere very seriously with smelting.

The Mount Thekla Mine.

The Mount Thekla Lode lies about 4 miles due north of Ewan, about half-a-mile across Oaky Creek. It occurs in upturned sedimentary rocks which strike in all directions, dipping generally at steeply-inclined angles. A few chains north of the mine granite occurs, and the junction between the two formations can be followed with the eye across the hills by the rougher character of the country, and the browner appearance of the vegetation, on the granite side of the line. The lode crops out strongly up the brow of a hill, facing to the north, and situated at the head of a gully, which leads down into Oaky Creek and gives a good outlet for traffic on to the more level country round Ewan. The outcrop shows green carbonates of copper and oxides of iron in a felspathic and sandy matrix, merging into a fine pebbly conglomerate. It can be followed nearly to the top of the hill, where the outcrop of the shoot

of ore apparently ends. The conglomerate is seen on the surface, and with greater clearness in the workings, to be interstratified with a bed of clay shale on the west and one of hard compact quartzite on the east. These beds strike almost due north and south, and dip steeply to the west. The conglomerate consists of well-rounded quartzite pebbles in a felspathic and sandy matrix, and is about 30 feet in thickness from the clay-slate hanging-wall to the quartzite. Near the clay-slate it is finer in grain and approaches more to a felspathic sandstone in character. The lode material occurs along the junction plane between the clay-slate and the conglomerate and impregnates the latter to a varying distance from this junction plane, the impregnation fading off more or less suddenly as the conglomerate becomes coarser.

The clay-slate thus forms a well-defined hanging-wall to the lode, the footwall lying in the conglomerate itself and being much less definitely marked. Plate II. is a vertical section across the lode and enclosing rocks. The lode varies from 3 or 4 feet to 10 or 11 feet in thickness and shows an average of probably about 6 feet of the richer ore. Near the surface, where it has been altered by atmospheric agencies, it shows earthy carbonates and oxide of copper and iron. Lower down bornite, black oxide, pyrites, and galena make their appearance, while in the lowest level the lode is an intimate mixture of copper pyrites, galena, and blende, with some earthy material through it.

The lode has been worked along three levels as shown on Plates II., III., and IV. The upper tunnel, about 24 feet in length, was put in across the strike of the lode in a direction bearing E. 25° S. After exposing the junction of the clay-slate and lode it passes diagonally through a thickness of about 6 feet of the latter, showing carbonates and oxides of copper in an earthy and sandy matrix. For the rest of the way it is in barren conglomerate. A drive was then made along the lode keeping the clay-slate wall on the right for a distance of 42 feet. It is finished off at the end by a crosscut going east into the footwall for about 13 feet from the hanging-wall. The roof, left-hand side, and end of this drive show evidence that the lode has been ore-bearing right along. The crosscut at the end exposes from 6 feet to 8 feet of lode. Messrs. Lennox and Rannie, the owners of the mine, informed me that about 40 tons of ore were obtained from this tunnel, which they estimate from numerous assays to carry, on the average, 26 oz. 12 dwt. of silver per ton and 22 per cent. of copper. This ore was stacked at the mouth of the tunnel. If the above estimates are correct it represents a value of £720 worth of ore from 42 feet of driving. In addition to this there still remains a considerable amount of ore not yet broken down on the left-hand wall of the tunnel.

A second tunnel has been put into the outcrop about 24 feet below the former, and goes diagonally across the lode on a S. 28° E. bearing for 43 feet. The tunnel shows a little ore at the entrance, but soon passes into barren conglomerate. A crosscut at the end goes east and meets the quartzite footwall rock in 12 feet. A diagonal crosscut towards the hanging-wall goes on a bearing of W. 40° S. and meets the clay-slate hanging-wall in 20 feet. The width of the conglomerate and lode at this point between the clay-slate and quartzite is almost exactly 30 feet. The lode shows about 7 feet in width in the westerly crosscut against the clay-slate hanging-wall. It has been followed by drives keeping to the the clay-slate hanging-wall to the north for 23 feet, and to the south into the hill for 44 feet. A crosscut from a point 24 feet along the southerly drive into the footwall is in 11 feet from the hanging-wall, and shows about 9 feet of lode material. Plate IV. shows a horizontal section through the lode at the level of this tunnel.

A shaft has been sunk on the outcrop of the lode from the level of the lower tunnel and from a point 23 feet in a north-westerly direction from it. It is 20 feet in depth, and passes through the clay-slate hanging-wall rock till it meets the lode-bearing material near the bottom. A little ore is seen here and on the sides of a drive going E. 37° S. diagonally across the conglomerate bed, from the bottom of the shaft. The drive takes this bearing for 13 feet 6 inches, then goes S. 22° E. for 12 feet, and finally W. 35° S. for 16 feet, when it meets the clay-slate hanging-wall. The ore body is here about 12 feet in thickness. A drive on a bearing S. 22° E. from this point goes through sulphide ore to meet a winze from the upper tunnel level in 30 feet. As the winze starts on the hanging-wall, and is vertical while the lode is dipping east, this level did not quite keep to the hanging-wall. The latter, however, was subsequently broken into along the level, and a width of about 10 feet of lode material is then exposed at the winze. The ore here consists of copper pyrites, galena, and zinc-blende, with some bornite and black oxide, showing comparatively slight alteration.

Messrs. Lennox and Rannie gave me the following estimates of ore taken from the lower tunnel and shaft workings. This ore was stacked at the shaft head, and the best of it was being got ready for bagging and conveyance to smelting works.

Forty tons sulphide ore from the bottom level, estimated by sampling and assaying to carry—

	1st Sampling.	2nd Sampling.
Silver	86 oz. 17 dwt. per ton ...	... 121 oz. per ton.
Copper	21·375 per cent. ...	... 22 per cent.
Lead	8·65 „	
Zinc	4 to 5 „	

Thirty-five tons of carbonate ores from the lower tunnel, estimated by sampling and assaying to carry—

Silver	22 oz. 17 dwt. per ton.
Copper	21·385 per cent.
Zinc	4 „
* 200 tons seconds, estimated to carry	silver, 20 oz. 18 dwt. per ton. copper, 15·75 per cent.
* 5 „ „ „ „	silver, 10 oz. 15 dwt. per ton. copper, 10 per cent.
* 80 „ „ „ „	silver, 20 ozs. per ton. copper, 18 per cent.

* Obtained from different parts of lower tunnel and bottom levels.

A rough sample of the ore taken by myself from the 40-ton heap of sulphides, and analysed at the Government Chemical Laboratory, gave the following result:—

Silver	163 oz. 17 dwt.	per ton
Copper	16·90	per cent.
Lead	18·50	„
Zinc	10·10	„
Iron	7·60	„
Silica and insoluble	5·05	„
Sulphur	22·38	„
Undetermined	19·47	„
	100·00	„

Owing to the pressure of work at the Government Laboratory, I was unable to have the complete analysis of the ore determined in time for this report. The above analysis, however, gives a fair idea of the complex nature of the ore as well as of its value in minerals.

The following are analyses of ore from the Lake George Copper Mines, Captain's Flat, New South Wales. They show that the two ores are comparable in many respects. The analyses are taken from "The Copper Mining Industry of New South Wales, by J. E. Carne, F.G.S., Geological Surveyor, page 127":—

	Bulk Ore.	Silver Ore.
Silver	1·15 oz. per ton	3·03 oz. per ton
Gold	·04 „	·06 „
Copper	1·25 per cent.	·94 per cent.
Lead	9·70 „	8·05 „
Zinc	13·26 „	14·28 „
Iron	22·26 „	15·19 „
Silica	21·55 „	26·48 „
Sulphur	29·50 „	27·50 „
Lime	1·60 „	—

Speaking of the smelting of this ore Mr. Carne says (*loc. cit.*)—

"Under the new method of reduction (by pyritic smelting in blast furnace) the matter is brought up to a marketable grade—30 to 35 per cent. copper—in one operation, thus avoiding the previous extra cost of concentration in attaining this grade.

"The composition of a recent consignment can be judged from the following partial analysis, the gold and silver contents not being stated:—

Copper	34·01	per cent.
Iron	20·85	„
Zinc	9·90	„
Lead	11·75	„
Sulphur	22·00	„

Gold, 1·63 oz. per ton.
Silver, 60·00 oz. „

"Naturally, the proportions of the furnace charges (which are varied to suit the idiosyncrasy of each furnace) are matters of commercial secrecy. The constituents, however, are about 12 cwt. of sulphide ore, with variable quantities of limestone, ironstone (from the Commodore Mine), and slag from the fire-hearths and separators. About 3¾ to 4½ per cent. of carbonaceous fuel (coke) is added to each charge.

"Limestone is procured about 3 miles from Captain's Flat, along the Bungendore road.

"The silica in the ore is just about sufficient for fluxing requirements.

* * * * * * * * * * *

"Barring-down is performed about every fifth day to remove the crust formed, chiefly of oxide of zinc. The operation requires about three hours to complete. . . . .

"The Lake George Mines furnish an instructive and valuable object lesson on the possibilities of pyritic smelting."

As far as can be seen at present, the Mount Thekla Ore compares very favourably with the above as a smelting problem. The valuable contents—silver and copper—are very much higher, the percentages of iron and silver are in much the same proportion in either ore; the sulphur percentage is not very appreciably less, while that of zinc is 3 or 4 per cent. less.

Messrs. Lennox and Rannie informed me that since my visit they have despatched 125 tons of ore to the Aldershot Smelting Works, with the following results:—

115 tons returned at the rate of 35 oz. silver per ton, 21½ per cent. copper, and 10 per cent. lead.

10 tons gave 181½ oz. silver per ton, 29·2 per cent. copper, and 10 per cent. lead.

The percentage of zinc was not given.

There is no doubt that this mine, if it continues to develop at a depth and when followed into the hills as it has in the shallower workings, will in the near future turn out a profitable producer. Judging by the indications on the surface the shoot of ore is not a very long one, and the first thing to be determined is the length of the shoot and the possibility of picking up others. In depth it may perhaps decline considerably in metal contents, but it shows every likelihood of being a permanent lode, and its high contents in valuable metal will stand a very considerable reduction before the ore can be considered a poor one.

The Macaulay Creek Mines.

The lodes at Macaulay Creek occur in granite country in association with dykes of quartz-felspar, porphyry, and dolerite. The granite is made up of pink orthoclase, quartz, and a massive green amorphous mineral, no doubt an alteration product of muscovite. The dykes trend east and west. The ore deposits at the Copper Knob Mine and the Prospecting Area are associated with elvan, while those at the Western Mine and Mount Long are associated with dolerite. The ore occurs in irregular masses and pipes in an altered "formation" rock. This "formation" is composed mainly of quartz and a greenish amorphous alteration product, probably of some felspathic mineral. It has slickensided faces running through it, showing evidence of movement and crushing. It does not occur with well-defined walls dividing it from the granite, but passes more or less rapidly into the granite along fairly easily recognisable lines. It has apparently been formed by the alteration of the granite along certain fissure planes which have allowed of the alteration of the felspar and other silicate minerals of the granite by means of percolating waters. The ore consists of sulphides of copper, lead, and zinc, and besides occurring in larger masses and pipes is also found scattered through the formation in proportions too low to form payable ore.

The general composition of the ores is shown in the following average analyses of samples from the four mines, kindly given me by Mr. Harper, the manager :—

Average Analyses of Ores from the Macaulay Creek Mines, Kangaroo Hills.

	202 Tons from the Western Mine.	284 Tons from the Prospecting Area.	465 Tons from Copper Knob Mine.	124 Tons from Mount Long Mine.
	Per cent.	Per cent.	Per cent.	Per cent.
Copper	12·50	4·00	3·65	2·45
Lead	12·00	8·80	7·17	6·50
Zinc	6·78	2·60	3·10	2·89
Silica (SiO_2)	38·25	55·63	51·87	54·70
Iron (FeO)	5·51	Traces	Traces	1·66
Alumina (Al_2O_3)	12·72	17·40	22·70	19·53
Lime (CaO)	4·16	7·14	8·12	7·00
Sulphur	6·03	Traces	Traces	Traces
Undetermined	2·05	4·43	3·39	5·27
	100·00	100·00	100·00	100·00
Silver	133·17 oz. per ton.	13 oz. per ton.	26 oz. per ton.	14 oz. per ton.

The Western Mine.—The accompanying plan, Plate V, shows the work that has been done on this mine. The shaft A was sunk to a depth of about 30 feet, on an outcrop of copper ore, by the prospectors. It gave a quantity of rich ore which was bagged and sent away to smelting works, and gave a good return for both silver and copper. A second outcrop of ore was found by the present owners at C, about 50 feet further south, and the lode being judged to run from A to C, and to dip to the west, a shaft was sunk at B to intersect the lode to the dip. It was stopped at a depth of 52 feet. The shaft A was thus 32 feet deep in poor ore. On further sinking, rich ore consisting principally of bornite was met with, carrying a high percentage of silver. A sample of this bornite, assayed at the Government Chemical Laboratory, gave a return of 38·75 per cent. of copper and 120 oz. of silver per ton. The shaft was carried down to 52 feet, when it met with a floor of granite, dipping steeply to the west. This floor was followed down on the underlie for another 18 feet. The ore in this shaft occurs in the "formation" rock described above. This formation apparently runs in a S.E. and N.W. direction, as shown on the plan, for a crosscut put in across the apparent run, as indicated by the granite wall met in sinking the shaft, passed in a foot or two again into granite. The ore body apparently occurs as a pipe in this "formation," for on driving along the formation S.E. and N.W. the ore body was left behind in a few feet from the shaft. I was unable to see the bottom of the shaft, which was full of water. The crosscut starts at a depth of 56 feet. At about 22 feet formation rock of similar character to that found in the shaft is again met with on the right-hand side of the crosscut. This formation shows slickensiding, and carries a little mineral through it. Under the microscope it shows grains of quartz bound together by a semi-opaque green alteration product. The formation rock comes in on the left-hand side of the crosscut at about 28 feet in. At 31 feet in, the formation is intersected by a belt of soft decomposed rock, apparently an altered dolerite dyke. It is some 7 feet across, and cuts across the crosscut at right angles, forming well-defined walls, with a clayey selvage with the formation. On passing again into the formation, a second ore body was met with, and was opened out by a chamber some 8 feet across and 15 feet or 16 feet long. A drive from this chamber towards the shaft B soon passed out of ore, but continued on in "formation," carrying a little ore scattered through it. The granite was again met with at the bottom of the shaft. A second drive following the northern wall of the formation in a south-easterly direction met the southern wall in about 28 feet from the centre of the crosscut, the formation having narrowed considerably in this direction. At 22 feet in, the end of the drive shows the walls of granite and of altered dolerite to be about 2 feet 6 inches apart, the formation being represented by a clayey pug. The ore body at C apparently also occurs in the form of a pipe reaching up to the outcrop on the surface. Mr. Harper informs me that he has taken 175 tons from the shaft at A, and 27 tons from the chamber at C, the average analysis of which is shown in the table above. In addition to this he has obtained 130 tons from shaft A, and 40 tons from shaft B, which he classes as seconds, estimated from average assays to carry 28 oz. of silver, 4·93 per cent. of copper, and 4·4 per cent. of lead.

The Prospecting Area.—This mine lies some half-a-mile east of the Western Mine. The lode outcrops on the western face of a hill, and the "formation" can be traced in a north-easterly direction over the brow of the hill, and then in a south-easterly direction down the other side into a gully, the whole length of outcrop being about 8 chains. Plate VI. shows the disposition of the

workings. An open cut has been put in near the outcrop on the western face, and passes from granite into the footwall of the lode, as shown in the figure. A shaft sunk at this point follows down a distinct wall, dipping south at a steep angle to a depth of about 30 feet. Drives going east and west about 30 feet follow a clean footwall in a soft clayey dig, some 3 or 4 feet in thickness. Little or no ore has yet been met with in these drives. Mr. Harper gives me the following details of the ore taken from the open cut and shaft:—

19 tons assaying	17 oz. silver. 5·23 per cent. copper. 6·3 per cent. lead.
50 tons assaying	45 oz. 14 dwt. silver. 7 per cent. copper. 13·84 per cent. lead.
20 tons assaying	63 oz. 14 dwt. silver. 8·6 per cent. copper. 15·3 per cent. lead.

The outcrop of the lode appears to be broken and faulted as the east cut is approached, as shown in the plan. The outcrop does not give much indication of being richly copper-bearing on the surface. At the eastern cut another outcrop was opened out, and the ore followed down by a shaft on the floor of the cut, as shown in the plan. The shaft met with granite in a few feet from the surface. Mr. Harper estimates that he has 284 tons of ore from this open cut and shaft, the average analysis of which as obtained by him is shown in the table above.

The lode outcrops again strongly on the bank of the creek some 7 or 8 chains from the open cut, and looks well for copper. It is at present being broken down on a face from the bank of the creek.

The Mount Long Mine.—This mine lies to the north of the Copper Knob, on the crest of another hill. Plate VII. shows the plan of the ore outcrops and workings. Outcrops of "formation" carrying copper are seen running in a north-easterly direction up the side of the hill. A tunnel has been driven into the hill on a north-easterly bearing about 200 feet from the summit of the hill to follow the lines of these outcrops. It met with formation carrying ore at about 16 feet in. The tunnel goes in 72 feet, the last half being in solid granite. A short crosscut at 52 feet and another at the end, cut across an ore-bearing formation, which is apparently a continuation of that found in the tunnel. The second crosscut met formation again further on, and a winze was sunk on poor ore. The ore seam was followed in the granite till a distinct wall of a second formation was next met with, which was driven through to the further wall, giving the formation a nearly east and west direction. This formation was followed on the northern wall for some distance, and ore was met at 25 feet, and a winze sunk a few feet on it. In another 25 feet a dolerite appears on the right-hand wall, and this was pierced by a cross drive for 10 or 12 feet. Plate VII. shows a shaft at the top of the hill almost immediately above the end of this drive, from which about 60 tons of ore were obtained, which gave an average assay of 66 oz. 18 dwt. of silver per ton, 8·6 per cent. of copper, and 22·89 per cent. of lead. From the tunnel 124 tons in all were obtained, the average of analyses of which are given in the table above. The shaft is 25 feet deep, and shows the ore formation, which is from 3 to 4 feet wide at the surface on a well-defined wall of granite pinched to a few inches at the bottom. The formation has an east and west trend, and is probably connected with that met in the tunnel below.

The Copper Knob Mine.—The formation carrying the ore in the P.P.A. is lost in the lower ground between that mine and the Copper Knob, but is found again up the slope of the next hill in a series of outcrops stained with copper. Plate VIII. shows the disposition of the workings. At the top of the hill it widens to about 16 feet in thickness, and a shaft has been sunk on the underlie for 27 feet at an angle of 1 in 2·5, which is in formation to the bottom. About 30 yards east of the shaft an open cut was put in on an outcrop of ore. The lode here is about 10 feet or 12 feet across. A considerable amount of ore was taken out. The lode dips to the south, and a shaft sunk on it from the floor of the open cut met a footwall of granite in 7 feet, and was continued on the underlie for 17 feet at an angle of 40 degrees from the vertical. The lode here narrowed, and a drive was made along it to the west for about 52 feet. This driving was abandoned when a horse of granite was met with on sinking and cross-cutting a few feet, the lode having been judged to have cut out. The formation in this drive carried a little ore in places, but not of a payable quality. From the manager I learn that in all 465 tons were obtained from the open cut, the average analysis of which is given in the table above.

The ore deposits at Macaulay Creek, though rich in places, are extemely irregular and patchy. They do not show much indication of turning out permanent ore producers at depths below the water line. The rich patches that have as yet been met with in the surface workings have apparently been brought into existence by infiltration of copper-bearing solutions into the "formation" rock, and by deposition of the copper in segregation masses where conditions were favourable for such deposition. Such redeposition and concentration of the ore cannot be expected to have gone on to any great distance below the permanent water line. Up to the present this water line has nowhere been reached except in the Western Mine, and it was inaccessible at that point, so that I had no means of judging of what character the ore was below it.

The True Blue Mine.

Dr. Jack thus reported on this lode in 1892—

"*True Blue* (161).—This lease is at the western end of a large lode which can be traced continuously for 1½ miles in an east 12 degrees north direction. Within the lease, to the east of the gully (one of the heads of the Donnybrook), the main lode has been pot-holed for some distance, and at a shallow depth begins to show carbonate of copper, and a little lower sulphides of copper and iron. A second large lode runs from the north-west corner of the lease across the gully on the north side of the main lode, which it visibly joins in the middle of the adjacent lease to the east (N 184). No. 3 shaft has been sunk on this northern lode, between the gully and the north-west corner of the lease, and shows green and blue carbonate of copper. Between the main and the northern lodes, a *cross lode* is seen

in the gully running north-west and south-east. This lode is at least 8 feet in thickness, and a shaft (No. 2) has been sunk on it to a depth of 25 feet. The face of a short drive south-east of the shaft shows a large body of copper ore, rich in silver; and flakes of native silver are seen on the adjoining quartz. The ore is bornite, or 'variegated,' or 'peacock' ore (sulphide of copper and iron), mixed with red oxide of copper, copper pyrites, and a little galena. The bornite is probably a decomposition product, and I should not be surprised if it gave place at the water level to copper pyrites and galena. . . . . About 12 tons had been raised up to 3rd December."

The shaft on the cross lode referred to above has since been continued down to 108 feet, passing through the footwall of the lode at about 25 feet. A crosscut N.E. from the bottom is in some distance, but has not yet met the lode. The bottom of the shaft was inaccessible. The south-east level at 25 feet has been driven 46 feet on the lode to a winze on good ore 2 feet 6 inches wide on the hanging-wall of lode. The winze is down about 50 feet, and has been carried up to the surface to make a continuous shaft 78 feet deep.

Underhand stoping to a depth of 12 feet has been done on ore 2 to 3 feet thick on the hanging-wall from the winze halfway to the main shaft. The level has been continued 18 feet further S.E. on a well-defined hanging-wall which is bearing round to the south. The good ore here has pinched out. The trend of this hanging-wall appears to indicate that this cross lode will cut the main lode a few feet further on. The lode in the level is siliceous with patches of galena and bornite, and, though comparatively poor, is at least 6 feet in thickness at the winze and even wider at the main shaft. Messrs. Lennox and Rannie informed me that they had sent away for smelting about 70 tons of ore from the drive, stope, and winze, the return from which was 20 per cent. copper, and 60 oz. silver per ton of ore. They estimate that they have 300 tons of seconds stacked at the shaft mouth, which, from frequent assays, should yield 12 per cent. to 14 per cent. copper, and 25 oz. to 30 oz. silver per ton.

[No. 167 of the Geological Survey Publications.]

Price 3*s*.]

By Authority: George Arthur Vaughan, Acting Government Printer, William street, Brisbane.

GEOLOGICAL SKETCH MAP
of the
Kangaroo Hills Mineral Field

To accompany Report
by
Walter E. Cameron B.A.
Assistant Govt Geologist
1901.

Scale 2 Miles to 1 Inch
2 1 0 2 4
H.W. FOX. LITH.

INDEX

- ~ Recent Superficial Alluvium
- G Granite
- S Altered Sedimentary Rocks (age undetermined)

Mitchell River
Mt FOX 2870 Ft
Four Mile Ck
Dray Road to Summit of Range
Eastern front of Coast Range
Summit of Range
Stone River (Eastern branch)
to Ingham
Spring Ck
Pappin's Selection
Francis Ck
to Ingham
Freeholds 166 & 198
Quart Pot Ck
Pine Apple Ck
Old Main Alluvial Workings
Prospectors Ck
PACKERS TRACK TO INGHAM
Kallanda Post Office
PROPOSED TOWN
Waverly Tin Mining Co's Offices
Planet Leases
Waverly Leases
RES.
Battery
Oaky Creek
Home Ck
Hidden Valley Stn
Hidden Valley Battery (Tin Lodes)
Mt Benham (Tin Lodes)
Running River
Douglas R.
Mt Thekla Mine
Douglas Mine
Copper & Tin Lodes
PROPOSED ROAD
BRIDLE TRACK
TRACK
ROAD
Boomerang Ck
Cattle Yards
DRAY ROAD EWAN & WAVERLY
Butterfly Gully
Oaky Creek
ITOWN RES.
Old Running River Co's leases
Mt Brown Tin Lodes
Bonny Brook Ck
EWAN
Williams Ck
Zig Zag Ck
BLAZED TREE LINE FOR ROAD
Falls 3 or 4 hundred ft in 2 miles
DRAY ROAD FROM TOWNSVILLE
BURDEKIN RIVER
RUNNING RIVER
BRIDLE TRACK
Spinifex Ck
Macaulay Creek Mines Office
Macaulay Creek
DRAY ROAD TOWNSVILLE TO EWAN
Running Ck

LOCAL SKETCH
Scale 16 Miles to an Inch

146 147
19
Lucinda Pt
HALIFAX
INGHAM
PALM ISLES
TRAMWAY
Terminus
HALIFAX BAY
Kangaroo Hills
Waverly
KANGAROO HILLS MINERAL FIELD
EWAN
MAGNETIC Ip
CLEVELAND BAY TOWNSVILLE
Cape Cleveland
TELEGRAPH LINE
Black R.
Ross R.
NORTHERN RAILWAY
DARE
Bald Hills St
Thorntons Gap
Continong
Star
Star Diggings Argentine (SILVER COUNTRY)
BURDEKIN
Basalt R.
Hillbrook
Keelbottom Ck
Dotswood St
Fanning River
Reid R.
Houghton
Fletchers Ck
DALRYMPLE
146
147

By Authority: GEORGE ARTHUR VAUGHAN, Acting Government Printer, William street, Brisbane.

CUY MANNERING LEASE

Waverley Tin Mines

from Waverley Company's Plans

Scale 120 feet to an Inch

To accompany Report on Kangaroo Hills Mineral Fields

By

Walter E. Cameron B.A.

Assistant Gov.t Geologist

1901

Fig 1. Plan

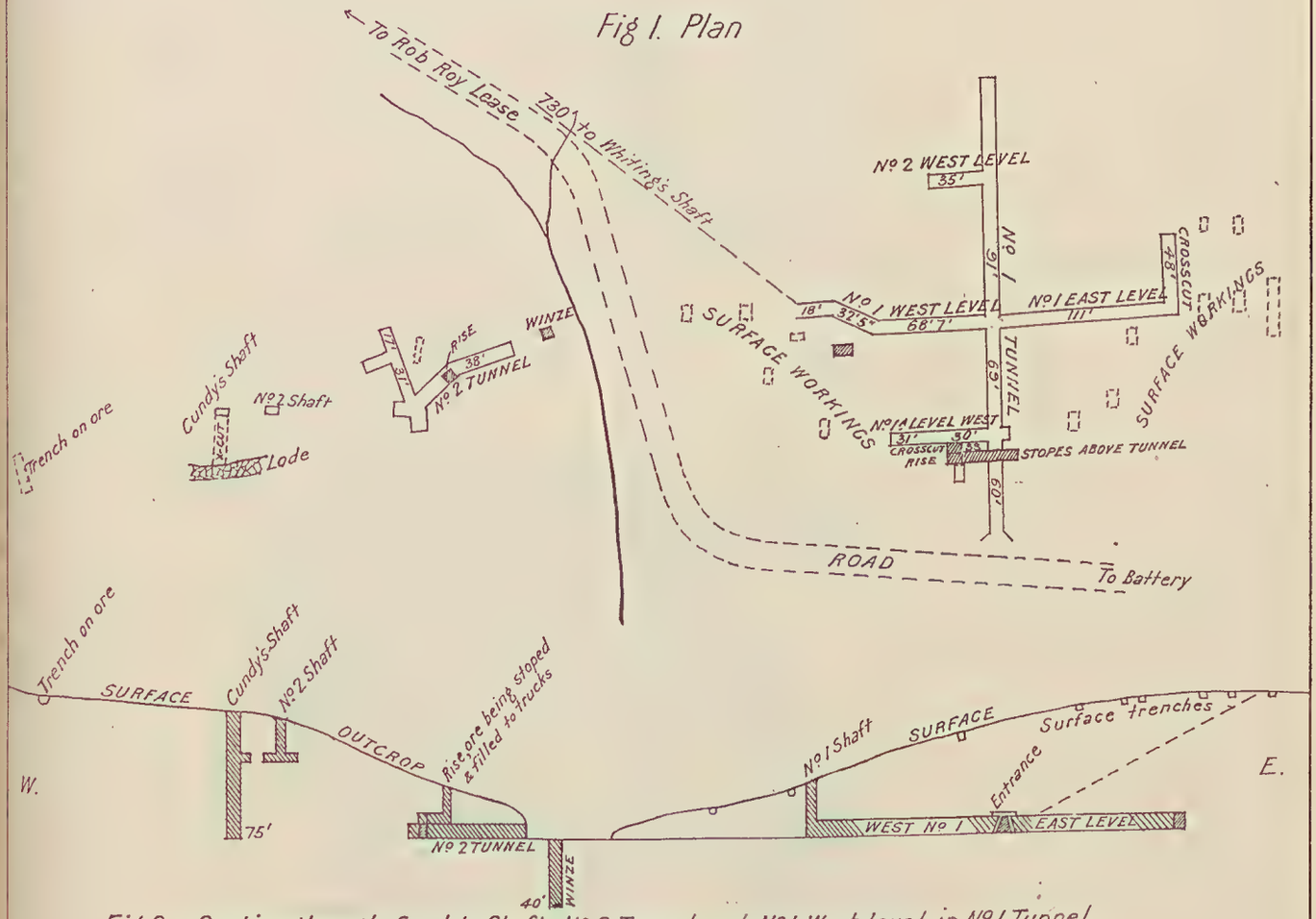


Fig 2. Section through Cundy's Shaft No 2 Tunnel and No 1 West Level in No 1 Tunnel

Fig 3. Section Stopes south of No 1A Level West in No 1 Tunnel

VICTORIA

Fig. 1

Vertical Section

Mt. THEKLA MINE

Kangaroo Hills

Mouth of upper tunnel and winze

Scale 20 feet to an Inch

To accompany Report on Kangaroo Hills Mineral Field

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Assistant Govt. Geologist

1901

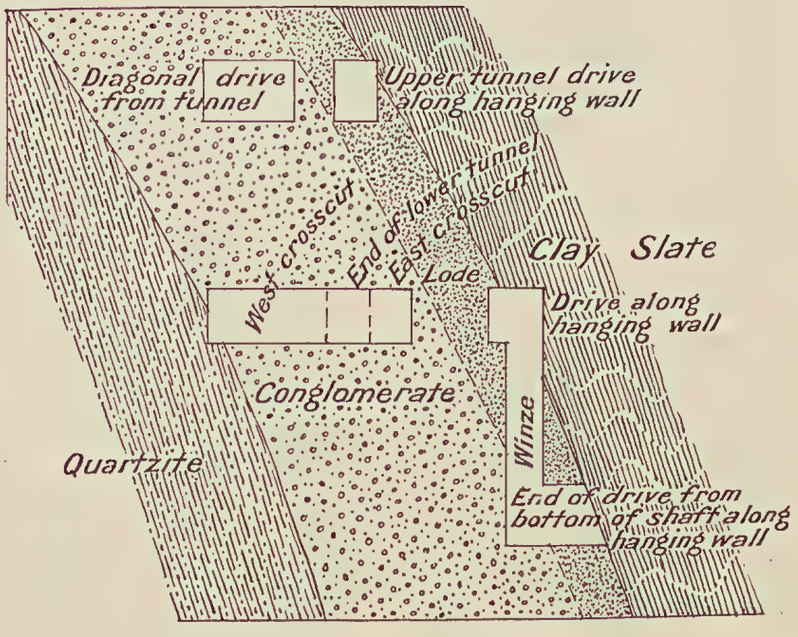

Fig 2

Section along Lode

Mt THEKLA MINE

Kangaroo-Hills

Shewing Workings on Lode in full lines and Workings off the Lode in broken lines

Scale 20 feet to an Inch

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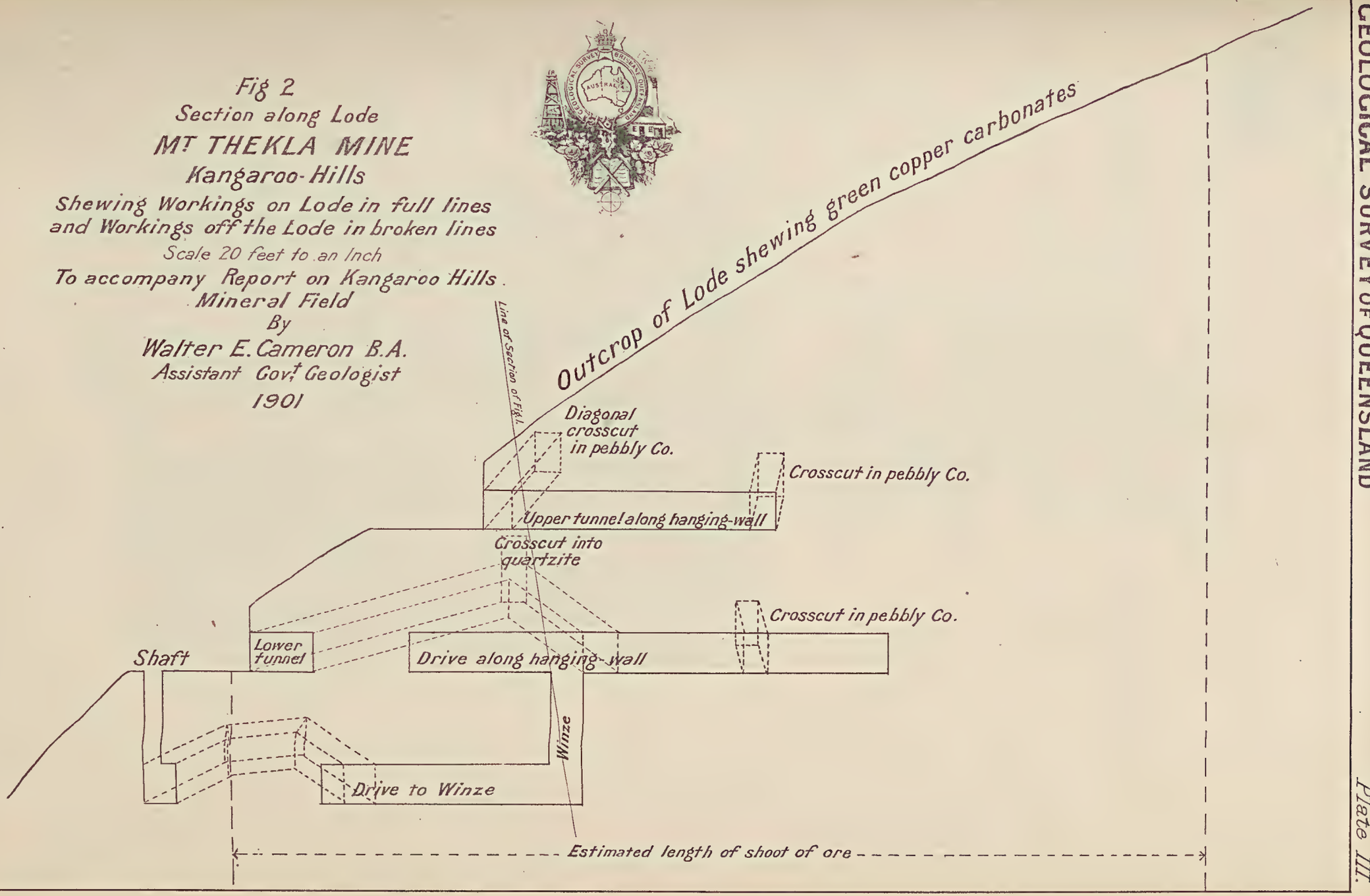
1901



GEOLOGICAL SURVEY OF QUEENSLAND

NATIONAL MUSEUM VICTORIA

Fig 3

Plan of Workings

Mt THEKLA MINE

Kangaroo Hills

Shewing position of Lode and accompanying formations at the lower tunnel Level, upper tunnel and shaft workings in broken lines

Scale 20 feet to an Inch

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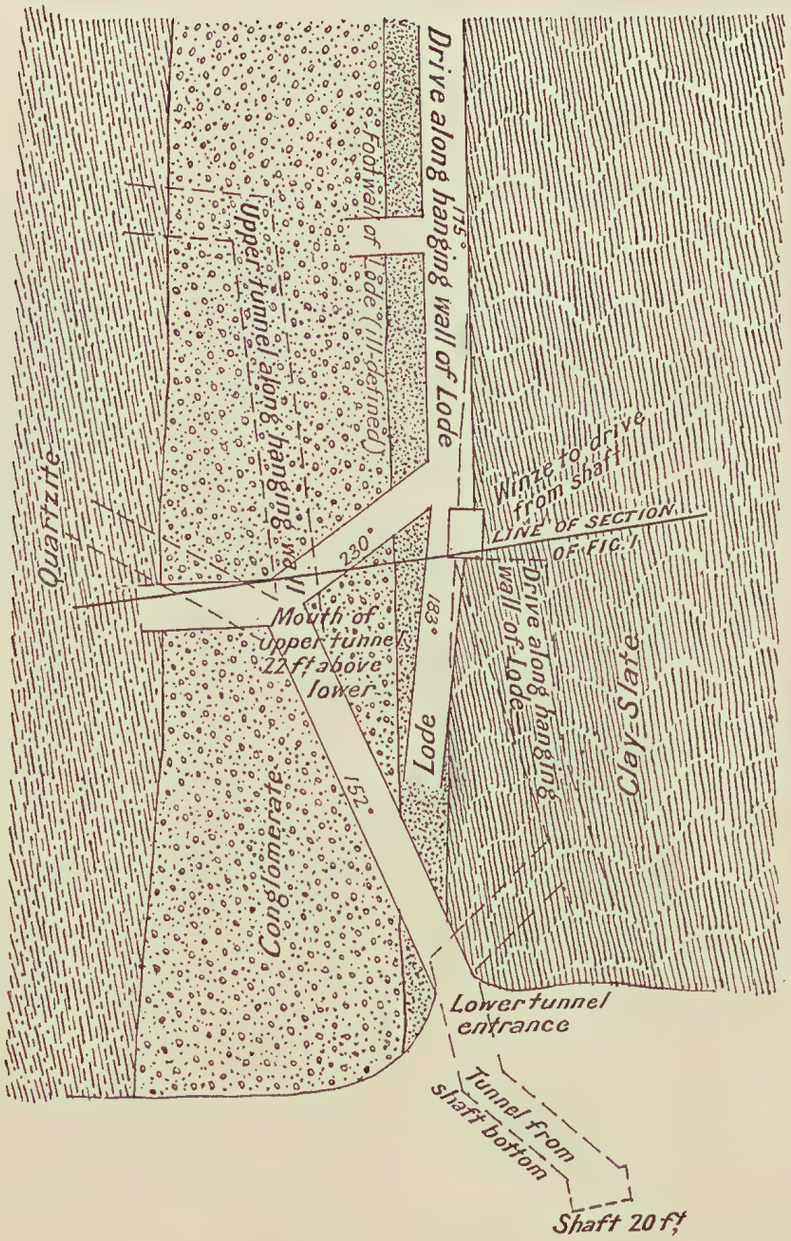
Assistant Govt Geologist

1901



NATIONAL MUSEUM VICTORIA

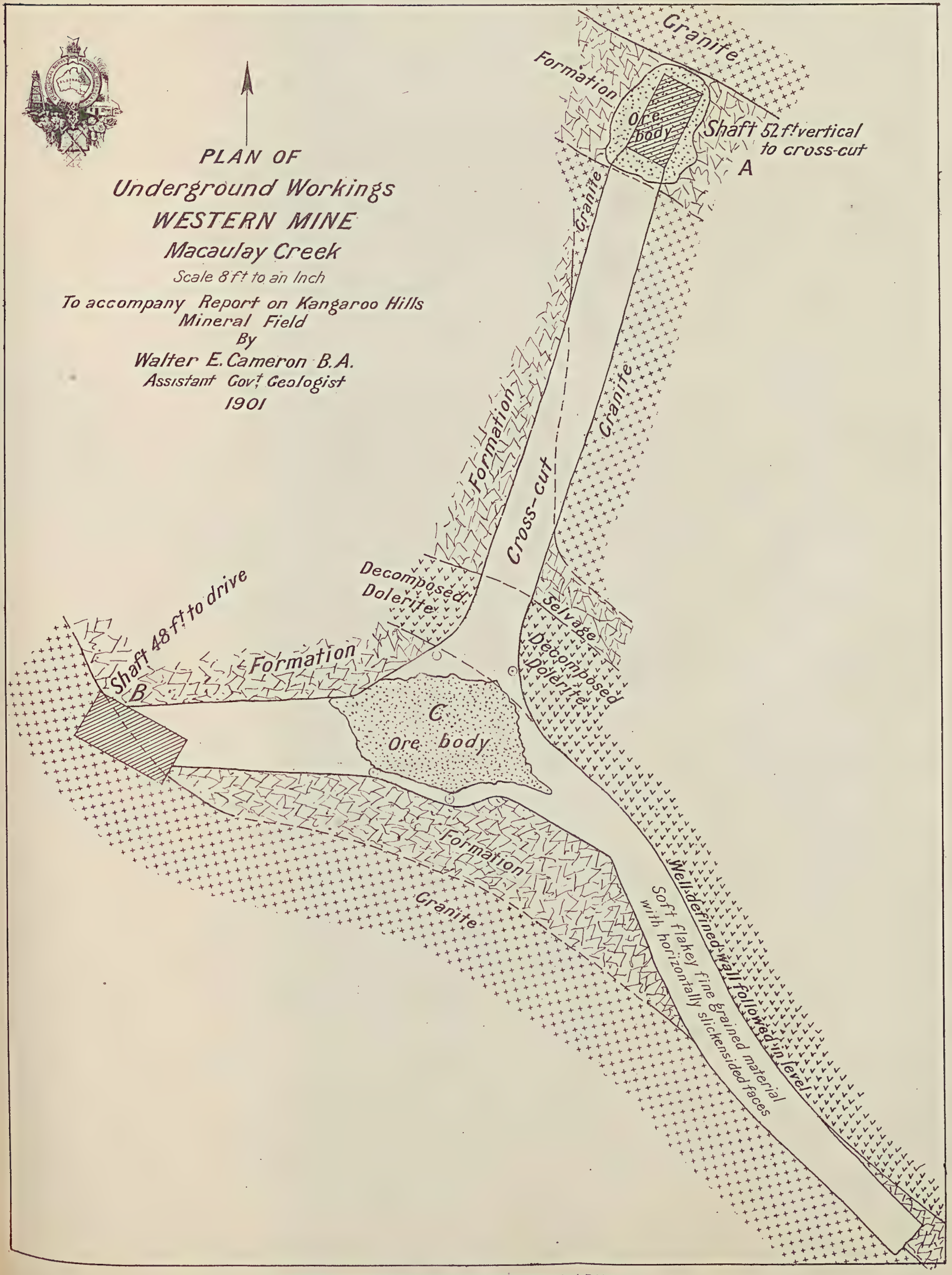
PLAN OF
Underground Workings
WESTERN MINE
Macaulay Creek

Scale 8 ft to an Inch

To accompany Report on Kangaroo Hills Mineral Field

By
Walter E. Cameron B.A.
Assistant Gov^t Geologist

1901



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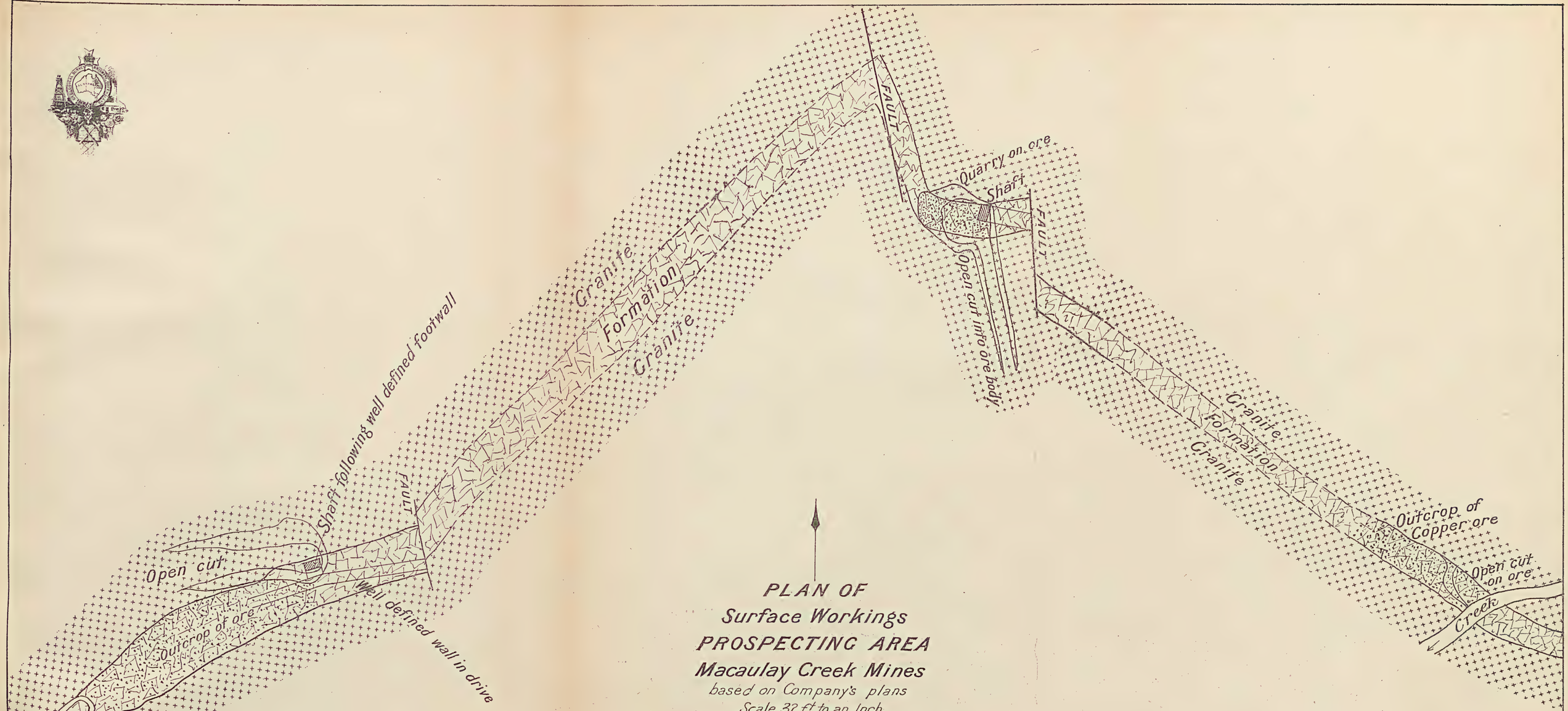

PLAN OF

Surface Workings

PROSPECTING AREA

Macaulay Creek Mines

based on Company's plans

Scale 32 ft to an Inch

To accompany Report on Kangaroo Hills Mineral Field

By

Walter E. Cameron B.A.

Assistant Govt Geologist

1901

By Authority: George Arthur Vaughan, Acting Government Printer, William street, Brisbane.

PLAN OF
Underground Workings
MT. LONG MINE
Macaulay Creek

Based on Company's plans
Scale 16 ft. to an Inch

To accompany Report on Kangaroo Hills Mineral Field

By
Walter E. Cameron B.A.
Assistant Govt. Geologist

1901

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PLAN OF
Underground and Surface Workings
COPPER KNOB MINE
Macaulay Creek

Based on Company's plans

Scale 16 ft to an Inch

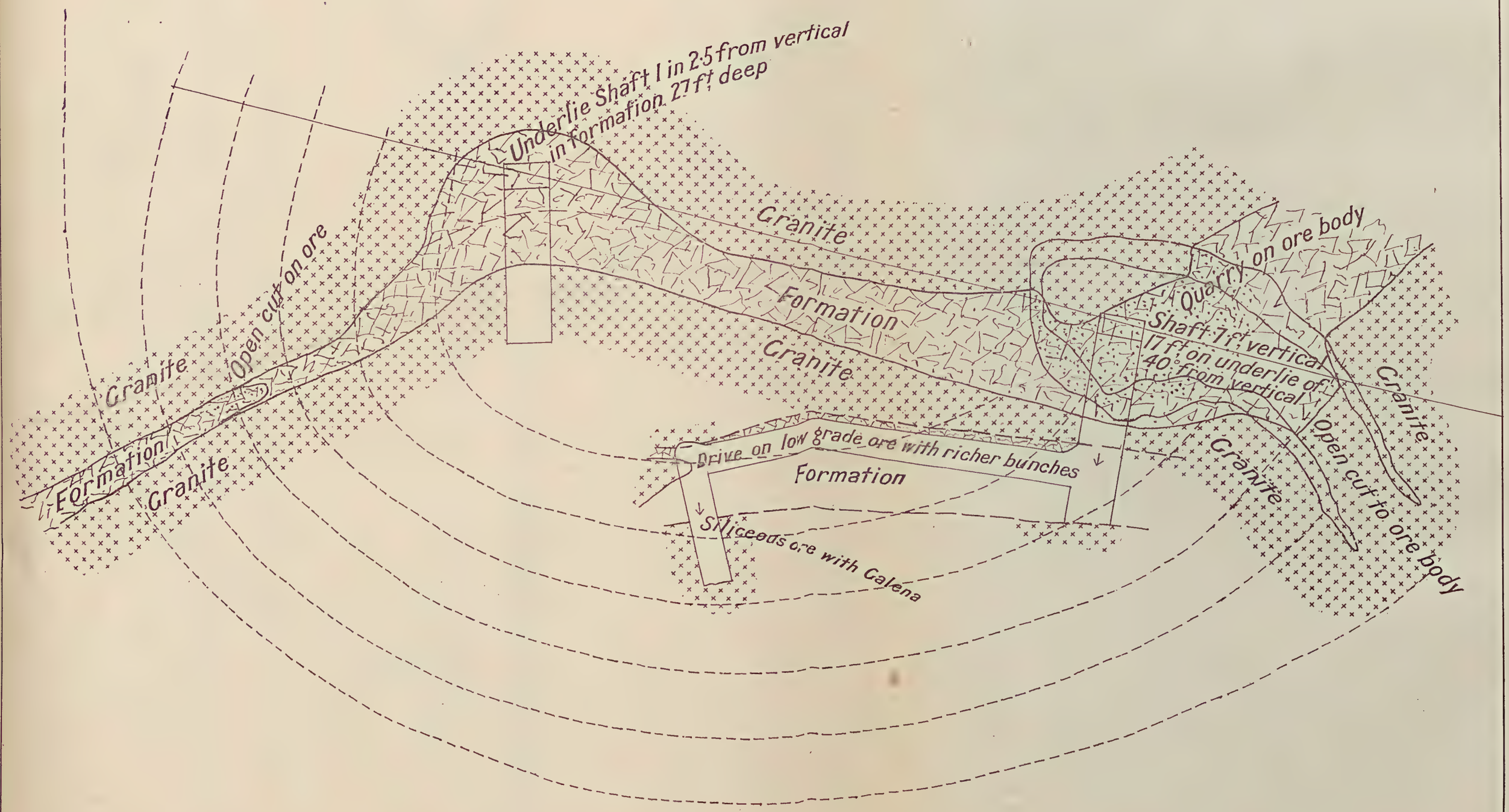
To accompany Report on Kangaroo Hills Mineral Field

By

Walter E. Cameron B.A.

Assistant Govt Geologist

1901



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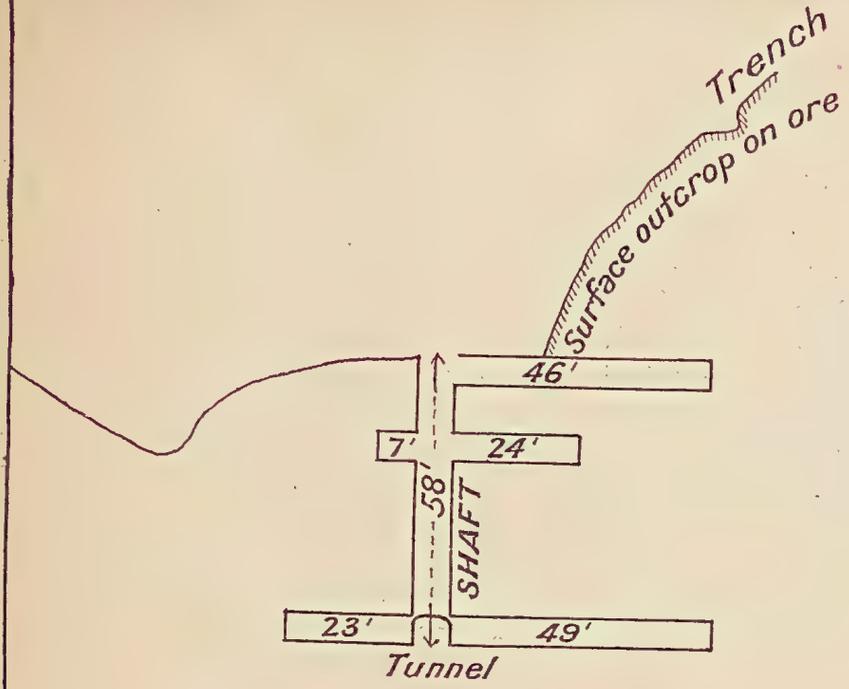
PLAN & SECTION
of Workings
DOUGLAS TIN MINE

Scale 40 feet to an Inch

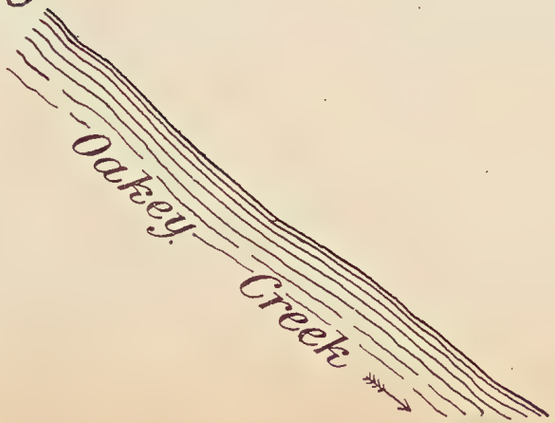
To accompany Report on Kangaroo Hills Mineral Field

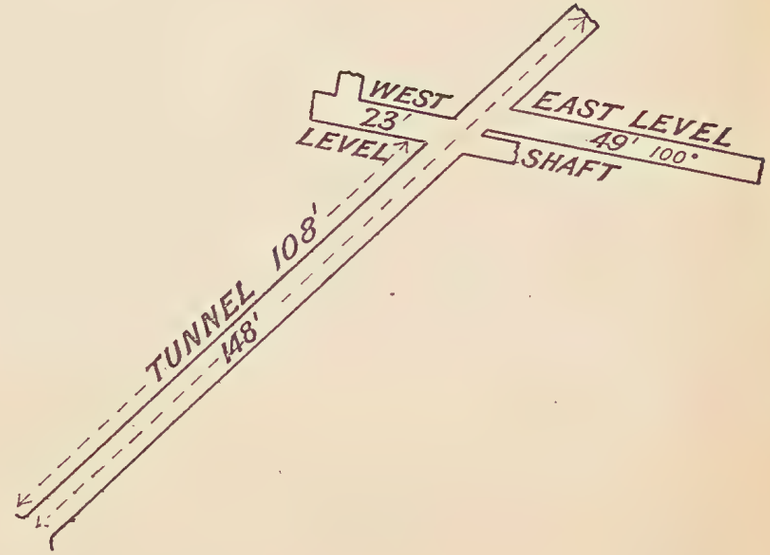
By
Walter E. Cameron B.A.
Assistant Govt. Geologist

1901



Vertical Section of Workings along Lode





Plan of Workings on Tunnel Level

By Authority: George Arthur Vaughan, Acting Government Printer, William street, Brisbane.

GEOLOGICAL SURVEY OF QUEENSLAND

VICTORIA

168

VICTORIA.

1901.

QUEENSLAND.

STANTON-HARCOURT DIGGINGS AND THE MOUNT SHAMROCK MINE.

(REPORT ON THE, BY LIONEL C. BALL, B.E., ASSISTANT GOVERNMENT GEOLOGIST.)

[*With 2 Maps, and 15 Plates.*]

Presented to both Houses of Parliament by Command.

TO THE UNDER SECRETARY FOR MINES, BRISBANE.

30th August, 1901.

Sir,—I have the honour to enclose herewith Mr. Lionel C. Ball's Report on the Stanton-Harcourt Diggings and the Mount Shamrock Mine.

WILLIAM H. RANDS, Government Geologist.

STANTON-HARCOURT DIGGINGS.

LOCALITY.

Stanton-Harcourt Diggings lie 11 miles north of Degilbo and 17 miles south-south-west of Childers. Almost all the workings are within the catchment area of Stony Creek, which flows into Tarwar Creek 2½ miles above the Burnett River. The main road from Degilbo to Paradise runs within half-a-mile of the workings and a rough bridle-track runs from there to Childers.

For two miles from Childers Railway Station the red basaltic soil of the Isis Scrub is seen, and then, on descending a hill, it is found to be underlaid by highly indurated claystones. Just before reaching Huxley alluvial clay, containing traces of vanadium compounds, and formed by the decomposition of claystone, has been used with success for making bricks. Claystone extends to Woocoo Creek, some five miles distant, an outlier of red soil occurring on the left of the track at the head of Appletree Creek. Between Woocoo Creek and Corfield Creek, biotite granite occurs, and then lydianised Gympie clay-stones overlie it. These continue to Stony Creek (near which they are covered by volcanic rocks) and beyond it to the west. The belt of volcanic rocks probably extend south past Dallarnil on the east to Biggenden.

Grass is abundant on the cleared volcanic hills about Stony Creek, and makes a welcome change after the higher comparatively barren country towards Childers.

With regard to the country to the south-west of the field on the Paradise-Degilbo Road, the slate outcrops from under the volcanic rocks in Stuckey's Selection, the fertility of the soil decreasing at once. From Dallarnil Post Office to the reserve on Emu Creek scrub is passed through; the rock appears to be a slate in the earlier portion, but it is probably andesite that forms the red soil seen on the latter part. Beyond the reserve to Degilbo the rocks may be assumed to be slate.

HISTORY.

From the men on the field I learnt that gold was discovered in 1885 by boundary-riders, when repairing the old fence between Stanton-Harcourt and Degilbo Runs, on the top of the range to the east of Stony Creek. The place is now known as Stains Gully, and is sometimes referred to as the Tableland.

Gold was followed down the gullies to the west, and the flats along Stony Creek were tried last.

Mr. Rands visited the workings in 1886,* and found that most of the work had been on alluvium, though a few small leaders were being prospected near the junction of Stony Creek and Slimy Gully. Far more work must then have been going on than now, but it did not last many months.

In 1888 there seems to have been a slight revival in alluvial mining on Stony Creek, but it was of a short duration, owing to trouble experienced in dealing with the water in the gravels. Dredging areas and claims were applied for in 1889, but not taken up.

At the time of my visit practically nothing was being done except on the alluvium, all reefing shafts, except those on Brown and Daly's Claim, being either flooded or in a state of collapse, and there were not more than a dozen men on the field.

* "Report on the Gold and Siver Deposits in the neighbourhood of Mount Shamrock," by William H. Rands, Assistant Government Geologist. Brisbane. By Authority: 1886.

GEOLOGY.

Slates appear to underlie the whole of the country in the neighbourhood of the Stanton-Harcourt Diggings, stretching from Corfield Creek, on the east, to the junction of Stony and Tarwar Creeks, on the north-west.

Most of it has, however, been covered by basic (doleritic) tuffs and flows of amygdaloidal andesite, and all these are intersected by narrow but persistent dykes of the more acid trachyte and veins of ankerite.

Evidently the basic eruptions took place first, showers of basic tuff and breccia preceding the outburst of andesite. The trachyte—intersecting slates, dolerites, and andesites—is of course the youngest. The areas covered by these rocks have been roughly delineated on the accompanying map.

The andesite forms gently rolling country, and gives rise to splendid soil, but the more basic rocks cause steeper and more rocky hills, though producing good soil. The slate country is broken and stony with comparatively poor soil. The dykes of trachyte apparently act as subterranean waterways, for, although there is little soil on their outcrops, they all support scrub vegetation, which causes them to be quickly noticed.

Extensive black-soil flats, due to the decomposition of the volcanic rocks, are found along Publicans Gully and Stony and Tarwar Creeks. These flats consist of alluvial deposits of various depths, which are water-bearing perennially, though Stony Creek and its tributaries are flowing streams only for short periods after rain.

ALLUVIAL WORKINGS.

As the alluvium in the gullies below the tableland is considered to be worked out, the gravel in the bed of Stony Creek and the shallow ground along Slimy and Stains Gullies are the only deposits being attended to at present. There are two men on the creek, and one on each of the gullies.

Men seem to be able to just provide themselves with food and clothing by working on Stony Creek, and hence this is a last resort for them.

Stains Gully cannot be more than an acre in extent. The gold here is fairly coarse and rough, and occurs in a thin layer of "wash" covered by a couple of feet of soil.

Slimy Gully alluvium is covered with from 6 to 10 feet of soil. The chief workings were along the creek for 50 yards, about 3 furlongs above Stony Creek. Other leads were worked lower down, on the left-hand side near a dyke of basic rock.

Duff's Claim is on the east of the old creek workings. Here the alluvium, in which the gold runs in well-defined leads, is about a foot thick, and at a slightly higher level than that in the creek. It is covered by 10 feet of soil. The gold would appear to have been derived from leaders on the hill above the claim.

Large flats have been extensively worked in the upper portion of Publicans Gully, but the lower flats have not even been prospected, probably because of the superabundance of water. The wash in the workings was from 6 to 13 feet below the surface. Great trouble was experienced with the water in the alluvial, a small portable engine and pump installed proving insufficient to cope with it.

It might prove profitable to dredge these flats, but test boring would be necessary in order to form a decided opinion.

The shallow alluvial slope, above Le Blowitz' Hut on Stony Creek, has been thoroughly worked, and Fulton's Flat opposite it was exploited till the water proved too strong. None of the shafts were timbered, and consequently they have generally collapsed. Colours of gold can be obtained by washing the gravel in the heaps from these shafts. This flat is 50 acres or more in area.

The wash under the flat opposite Miller's Hut is from 1 to 3 feet thick, and from 19 to 27 feet below the surface. A fair amount of ilmenite is present in the wash.

The largest flats are on Tarwar Creek, where two terraces can be seen. No work has been done on them, and I could get no colours on trying the wash in the creek.

REEFS.

Little can be said with regard to the reefs and lodes, beyond that most of them were tried many years ago and found too poor to pay. Only two parties are now at work. Almost all the reefs worked, up till the time of my visit, are within half-a-mile of the junction of Slimy Gully and Stony Gully.

Federal Claim.—The Federal Shaft is about a quarter of a mile up Nuggety Gully from Stony Creek. It was in working the rich alluvium of Nuggety Gully that the Federal Leaders were found.

The shaft, being in the gully, is flooded after every shower of rain. For a depth of 20 feet alluvium was passed through, and then some small leaders were struck. Below a depth of 25 feet the shaft was filled in, so all to be seen was in a drive opened for 1 fathom to the south-west, at the bottom of the wash. Here 3 to 9 inches of quartz rubble, between good walls, strikes north 60 degrees east, and dips almost vertically to the north-north-west. A sample taken from it yields:

Gold	3 oz. 14 dwt. 11 gr. per ton.
Silver	18 „ 7 „ „ „

The country on the field was thought to be diorite, but it is more likely to be a basic rock.

Girl-I-Left-Behind-Me Claim.—This claim is on the left bank of Stony Creek, a hundred yards or so above the entrance to Slimy Gully.

A considerable portion of the ground has been worked to a depth of about 6 feet for alluvial gold, and much of the remainder is considered by prospectors on the field to be payable.

Just east of the alluvial ground a trench has been dug on Daly's Old Quartz Reef, which is 18 inches in width, and which is running north-west and south-east. The shaft had fallen in. The country rock about here is a very basic eruptive one.

The leader, which had been worked till a couple of weeks before my arrival, when the drive and shaft collapsed, is a short distance south-east of Daly's Reef. It underlies to the north-west by north, and on it the shaft was sunk to a depth of 20 or 30 feet. A lode of ankerite, striking north-west by north, and underlying 60 degrees to the south-west by west, cut the leader in the shaft. The leader, which carries the gold, could not be tested, as it was completely covered by fallen rock and soil.

On the eastern portion of the area is a silver lode in slate-like rock. It varies from 1 to 6 inches where exposed in a small pit. The outcrop is in a gully, a covering of dolerite having there been removed. It consists of very compact brown iron-ore, with patches of galena, glance, &c. The strike is north by west and south by east, and the dip is 85 degrees to the west by south.

A ton of the material, tested at Aldershot, is said to have yielded 32 oz. of silver, and a few specimens taken by me assayed 8 oz. to the ton. This is, of course, far too poor to pay to work.

On the hillside east of the above claim is a 9-inch lode of banded calcite and ankerite, striking east and west, and dipping slightly to the north, in greenish slate. It carries a little galena and mispickel. There are a couple of filled-in shafts here.

Commonwealth Claim.—The Commonwealth is an old claim lying on the ridge between Nuggety and Hunter's Gullies and a couple of hundred yards north of Allan's Camp (the flat on Stony Creek, opposite Slimy Gully). A pit, 25 feet deep, has been made on a leader running east and west, and dipping 45 degrees to the north. The leader is a few inches wide, and consists of quartz and calcite.

A sample taken from it assays—

Gold	... 3 dwt. 6 gr. per ton.
Silver	... 2 „ 14 „ „ „

A lode of calcareous material runs north-east and south-west, on the side of the shaft, and dips 75 degrees to the north-west, so that it will soon cut the leader. It carries traces of gold and silver.

The country rock is a much-fissured slate, through which a couple of dykes of trachyte run to the north-north-west. The claim has just been retaken up.

Another laminated calcite and ankerite lode, known as Steely's, strikes west-north-west, half-way between the above and Allan's Camp, and it also is cut by a quartz leader, which is 3 inches thick, runs north-east and south-west, and dips steeply to the north-west. The country is slate. This lode was taken up for silver, but was abandoned after one pit had been dug.

Brown and Daly's Claim.—This is on the ridge between Slimy Gully and Stony Creek and about a mile from the junction. A rich quartz reef 9 inches thick was worked here by Daly some fifteen years ago. Only two shafts are now open. One of these is 40 feet deep on a quartz reef 2 feet thick, with 2 inches of flucan on both walls. The reef runs east and west and dips to the north at an angle of 60 degrees. As the quartz continues barren from the surface to the bottom of the shaft, it was abandoned.

A second shaft was then started to strike the old underlie shaft, in which it is believed the rich reef occurred. This is now 14 feet deep, in decomposed basic eruptive rock, but the old workings have not yet been broken into.

Conway's Lode, which lies just to the east of the above claim, consists of a couple of thin calcite veins and a quartz vein a foot thick, striking east and west and dipping 45 degrees to the north. An inclined shaft was sunk on it some years ago to a depth of 30 feet, but no returns seems to have been got from it. It may be the same reef as that in Brown and Daly's first shaft.

There is another reef, striking east and west, just south of Conway's Lode. It is a few inches thick and carries colours of gold.

Other reefs and lodes are:—

Lady Jane.—This is on the tableland, between Stony and Percy Thompson Creeks, at the head of Rison's Gully. There is a shaft 50 feet deep on a lode of calcite, striking north-east and south-west. This claim has been long abandoned and the shaft is in a state of collapse.

Clara.—A one-inch quartz leader, in 12 inches of yellow "pug," runs vertically east-north-east and west-south-west, a short distance west of the Lady Jane. The leader cut out a couple of feet below the surface, but the "pug" still contains traces of gold and silver and a little bismuth.

Dream.—A pit has been begun in the bed of a gully half-a-mile above the Childers-Degilbo Crossing, on Stony Creek. A fissure in slates runs north-north-west and south-south-east, and dips steeply to the east-north-east. The hanging-wall is hard and slickensided; the footwall is much fissured, and through it, for a couple of feet from the fissure, run veins and bunches of calcite impregnated slightly with pyrite. No prospecting has been done along the outcrop.

Lady Rachel.—This vein is on the eastern side of Slimy Gully just south of the Girl-I-left-behind-me Claim; it runs west-north-west and east-south-east, and dips to the east-north-east. The vein materials are calcite and quartz, and the country is basic eruptive rock. The shafts at the northern end have caved in, and that at the south (in the old No. 1. S. Claim), reported to be 90 feet deep, is flooded.

In selection 2190 are a couple of outcrops, probably of one lode, which were worked about fourteen years ago. One is a quarter of a mile south-west of Miller's Hut; it consists of a few inches of calcite with blende carrying silver.

The Paradise-Dallarnil Road passes close to the other outcrop, on which a fair amount of work must have been expended in the past. The lode material from the shaft (which it was not possible to descend) consists of calcite and ankerite with argentiferous zincblende. The strike of the lode is said to be north and south. The country on the west is a decomposed basic eruptive rock, that on the east being slate.

A few yards east of the main shaft is a lode consisting of 3 inches of ankerite, a horse of mullock 3 feet thick, and then 12 inches of ankerite with blende.

In McGuigan's paddock, about a mile and a half south of Allan's Camp, is a gossan lode, varying from 3 inches to over a foot in thickness, and carrying a little gold.

Several pits have been opened on this, but have all been abandoned for some time, and have caved in.

The only other workings to be noted are those on Mount Coomera, 4 miles south-east of Allan's Camp, where there are a few thin quartz leaders in slate near the dykes of trachyte. A trench and pits were dug on these, but have long been deserted.

MOUNT SHAMROCK MINE.

INTRODUCTION.

Locality.—Mount Shamrock lies in a straight line 5½ miles in a direction 60 degrees west of north from Degilbo Railway Station. The distance by coach road is a couple of miles greater. It is the terminal hill of the watershed between Chowey Creek and its tributary the Didcot.

History.—The discovery of gold on Mount Shamrock was reported in August, 1886, by the Gayndah Warden.

Ten claims were immediately taken up in the vicinity of the find, but gold was found only on the P.C. and Kent's Knob, and the others were consequently abandoned by the end of 1889.

The P.C. was sold in 1887 to an English Company, and then a 20-head stamper battery was installed and regular crushings were commenced.

In 1892, owing to a dispute between the English and Colonial Directors, the mine was shut down, but in the following year it was reopened and the main shaft was sunk to a depth of 390 feet. In the next year the workings were connected to the shaft.

During the greater part of 1895 the mine was idle owing to further trouble. A party of four tributers commenced work in the latter part of the year.

The mine, in 1896, passed into the hands of an Englishman from whom the company had borrowed money. Then the only work done was that by tributers, till 1900, when capital having been obtained by the sale of a certain number of shares, a large test crushing was made. Over 1,000 tons of picked ore yielded, on an average, only 3 dwt. 1 gr. per ton, and this is considered too poor to pay.

In the hope, however, that the breccia may be richer at a depth, it is proposed to intersect it by a drive from the bottom of the main shaft, which is said to be 150 feet below the present deepest workings —those on the 300-feet level. The manager estimates that the distance to be driven is "about from 160 to 200 feet to thoroughly intersect the ore body," and has made an application to the Mines Department for a £500 subsidy, to be paid at the rate of £1 for every £1 expended.

Difficulty in finding the shoot at 450 feet depth must be expected, for the dip will be irregular below the 300-feet level as it has been above. Taking the dip of the most eastern portion of the breccia exposed on the 250-feet level as one in two and a-half vertically, I have calculated that the breccia should be first struck 30 feet due south of the shaft, at the 450-feet level. The rich shoot, now being worked in the tributers' winze below the 250-feet level, should be found 167 feet south 33 degrees east from the same point, if the dip of the footwall remains one in one.

Though the grade of the ore, even in the rich shoot, has been gradually lowering till now the company considers it can no longer work the ore at a profit, it is improbable that there is no rich ore at a greater depth than 300 feet.

Mount Shamrock from the time of its discovery has been simply a gold mine—the only record of bismuth saved being that of 4 tons, in 1887.

Previous Reports. Mr. Rands, then Assistant Government Geologist, visited the locality in 1886.* The P.C. Shaft was at that time only 30 feet deep, and across it ran layers, dipping steeply to the east, of breccia, bismuth and iron ochres, and earthy hæmatite—all of which carried gold in considerable quantities. A trial crushing of 3¼ tons gave 6 oz. of free gold, the tailings carrying an additional 33 dwt. The bismuth, with which the gold was specially associated, amounted to only 1 per cent., though rich specimens assayed as high as 62 per cent.

Mr. Rands, in 1889, payed a second visit to Mount Shamrock.† He found the deposit to be a pipe of breccia, consisting of mudrock, with soft greyish tufaceous material interlaced with veins and fissures filled with sulphides of bismuth and iron, molybdenite, arsenical pyrites, quartz, lime, &c., the bismuth decreasing with the depth. It had been worked to a depth of 215 feet by a square shaft, 50 feet across, perpendicular for 140 feet, and then inclined to the south-south-east. Adits had been opened from the hillside proving the deposit to be 140 feet across.

TOPOGRAPHY AND GENERAL GEOLOGY.

The country about Degilbo is flat, and the rocks are of Permo-Carboniferous Age. The township itself is on altered slates. One and a-half miles to the east quarries have been opened on beds of limestone interstratified with shales striking north-north-west and dipping steeply west-south-west. This limestone contains fairly abundant remains of *Stenopora crinita*, crinoid stem joints, and small indeterminable Lamellibranchs; a few Gasteropods and Pentamerus casts are seen occasionally. The impurer portions are rich in Protoretepora. There is no outcrop of rock on the surface, but the soil on the limestone has the characteristic dark-red hue. Sandy glauconitic (?) shales succeed the limestone on the east, and then a belt of amygdaloidal andesite forms splendid soil over the Permo-Carboniferous Beds to within a quarter of a mile of the Biggenden Railway Station. Slates then extend to the east for about 5 miles from Biggenden, gradually rising towards the summit of the granitic coast range.

Deep-red soil is seen on the west of Degilbo, and points to there being a band of limestone (or possibly andesite) on that side also, but no outcrop of rock is visible from the main road.

A mile and a-half north-west of Degilbo Railway Station is the edge of the vesicular volcanic rock (spoken of by Mr. Rands in his 1886 report), which extends with one or two breaks to Black Gin Creek, a mile and a-half from Mount Shamrock.

Slates, altered to such an extent that they can scarcely be distinguished from felsite, then crop out and extend west through Mount Shamrock for 5 miles, when granite rises, forming the foot hills of the Bin Bin Range.

Mounts Shamrock, Ophir, and Melville are three isolated hills within half-a-mile of the junction of Didcot and Chowey Creeks—the first south-west, the second north, and the third south-east. Their respective elevations above the junction of the creeks are roughly 125, 300, and 300 feet. They all three consist of intensely altered slate, intersected in the case of the first and last by dykes of syenite, decomposed in various degrees and varying from black to white accordingly.

* "Report on the Gold and Silver Deposits in the neighbourhood of Mount Shamrock," by William H. Rands, Assistant Government Geologist. Brisbane. By Authority: 1886.

† "Report on the Biggenden Bismuth Mine, Gebangle and Mount Shamrock Mine," by William H. Rands, Assistant Government Geologist. Brisbane. By Authority: 1890.

GEOLOGY OF THE PIPE.

Country Rocks.—The slate of Mount Shamrock is an exceedingly fine-grained hard greyish felsite-like rock, showing not the slightest trace of bedding, but abundantly fissured in all directions, and breaking otherwise with a subconchoidal fracture. This has been called "mudrock" by the miners. The rock seldom shows local metamorphism when intruded by syenite, though actually fused to the latter; and the only changes that have occurred to it in the breccia are a certain bleaching and softening of the smallest fragments.

The time at my disposal did not allow me to determine on the field the origin of the "mudrock." It was, however, found to extend west to the Graecian Bend (2 miles west of Mount Shamrock) where a slaty schist occurs, and then again to the Chowey Reefs, a mile and a-half beyond, where it has been cut off by granite.

A change from the usual massive mudrock of Mount Shamrock occurs on the eastern flank of Mount Melville, a quarter of a mile east of the mine. Here it is schistose and sharply marked off from the massive rock. It is seemingly metamorphosed for 10 yards from the junction, but is probably on a fault.

Microscopic examination proves the mudrock to be an altered fragmental and probably sedimentary rock.

Syenite dykes are intimately connected with the ore deposit of Mount Shamrock, on the north and west, forming the footwall from the 100 to the 300 feet level.

This rock is very confusing, as it has tended to produce irregular sills or sheets, which bear some resemblance to those at Mount Morgan.*

As a rule, the syenite is spotted and very light in colour—sometimes almost white, owing to alteration; but zones are black, and look quite unaltered to the naked eye. When magnified, however, the light and dark rocks are seen to be one and the same in different stages of decomposition, none of the sections examined being free from alteration.

Prehnite crystals are found in vugs in the syenite on the 250-feet level.

At one place in the shaft, on the 190-feet level, the rock verges towards diorite in mineral composition.

The syenite may have risen at the time of the formation of the breccia, the fragments in the latter being torn off by the explosions which, though powerful enough to form the breccia, were unable to eject it completely from the pipe.† As, however, the syenite occurs chiefly in the country rock, a more probable explanation is that it was intruded prior to the formation of the breccia.

Sometimes the syenite is veined. At the shaft on the 190-feet level, where the rock is most basic, the veins are chiefly of quartz, but elsewhere carbonates and silicates are in excess. The calcite and quartz in the larger veins—the largest is 6 inches thick, and runs east and west through the Long Winze—is often beautifully crystallised in rhombohedra and hexagonal prisms and pyramids respectively. When less than an inch thick the calcite veins often carry sulphides—principally mispickel and blende. At the south-east end of the long drive, on the 300-feet level, is a 1-inch leader of calcite and iron pyrites (crystallised in combined cubes and octahedra), running vertically north-east and south-west through slightly decomposed syenite. The absence of arsenic is rather unusual.

Years ago a leader, in syenite on the 250-feet level, was worked for a short distance for telluride of gold and bismuth, but no telluride can now be obtained there. Many other leaders in the same rock, between the 200 and 250 feet levels, must have been rich in gold, to judge by the distances they have been followed. A rich leader was worked in the pigsty winze, above the 300-feet level.

Leaders of arsenopyrite are generally found on the junction of syenite and mudrock.

The Ore.—The workings thus far give no alternative but to designate the deposit a pipe, of which only the north-western semi-circumference has been yet exposed. The pipe is presumed to have a major diameter of 120 feet and a minor diameter of 70 feet.

The material of the pipe consists of slickensided agglomerate or breccia of the country rocks cemented by silicates, calcite, quartz, and powdered rock. Sulphides occur in this cement, at times almost to its exclusion. The separate blocks of mudrock forming the breccia are as often as much as 10 feet in smallest diameter, but as a rule they are less than 5 feet across and separated by still finer breccia or powder. The syenite in the breccia is usually in the form of slabs which may be 15 feet in length, though only 5 feet wide and 1 to 3 feet thick.

In different parts of the deposit these slabs have a distinct but variable dip now visible in only a few places owing to the coating of dust and soot on the faces. This rock, known by the miners as "sinter," is always much altered and generally is impregnated by sulphides, while the breccia in its immediate vicinity is almost always rich in auriferous sulphides; in fact, a layer of sulphides is found on most fragments.

The breccia as a whole is not even approximately homogeneous. The rock fragments are principally mudrock, but syenite is more plentiful in parts. The cement may consist chiefly of calcite and silicates, as seen on the 300-feet level, or of those minerals and quartz, the last mineral almost replacing the others on the 100-feet level in the door drive. It may contain no sulphides, as in the rise above the 300-feet level and on the 190-feet level towards the shaft.

The worked breccia consisted of a rich shoot, which is reported to have been less than a foot in diameter at the surface, so that a shaft of ordinary dimensions was sunk on it, but only to a depth of 30 feet. It was then found remunerative to work the larger portion now represented by the opencut. With depth the shoot assumed a flattened and much elongated form, the payable portion increasing greatly in size but at the same time decreasing in value.

The only difference between the breccia forming the shoot and the remainder is in the percentage of sulphides, as far as can be told from the little rich ore left.

The western and northern walls are everywhere sharply marked off from the breccia, the western being especially well defined. The north-eastern portion of the wall is not so easily distinguished, as the mudrock, for some distance from it, is much brecciated and the breccia sends irregular tongues into the country. (See sketch LK.)

---

* "Mount Morgan Gold Mine," by Robert L. Jack, Government Geologist. Brisbane. By Authority: 1898.

† "The Ancient Volcanoes of Great Britain," by Sir Archibald Geikie.

The western or footwall dips to the south-east, at an average angle of 80 degrees, to about the 200-feet level. The northern wall is almost vertical to a depth of 140 feet, where a projection of syenite and mudrock runs from the north into the lode. (See Plate IV.) Below this the dip of the wall under the western and rich portion of the lode increases slightly to the south, that of the remainder dipping east and south-east.

At about 200 feet depth a projection from the western wall half cuts the lode in two, a short "leg" on the north descending 40 feet and then cutting out; the main portion of the lode is carried almost horizontally to the south-east for 50 feet, and then dips again, but not quite so steeply and in a more easterly direction.

A comparison of the plans shows that the breccia, from having dipped to south-east, is now veering round and dipping in a more easterly direction.

Origin of the Pipe.—Mr. Rands, in his second report, definitely pronounced this to be a pipe. As far as the workings go, they certainly point to that, though they indicate that a flattening takes place with depth.

The smooth wall on the west and north and the very irregular one on the east seem to show that volcanic forces have elevated the brecciated rock for a greater distance on the west than on the east, the amount of energy available having been thus very limited.

Kent's Knob, which lies a quarter of a mile north-west of the Mount Shamrock Mine, may be a subsidiary pipe, uniting with that of Mount Shamrock at a depth. It consists of similar breccia, a sample of which carried a trace of gold and 6 dwt. of silver per ton.

The Origin of the Minerals in the Breccia.—As already mentioned, the syenite of the dykes is much altered, the original ferro-magnesian mineral being completely decomposed into viridite and oxides of iron, and the felspar kaolinised to a greater or less extent. Secondary carbonates and quartz are abundant, and have probably the same origin as those minerals so plentiful in different parts of the breccia and forming veins in the syenite. Carbon dioxide gas may be assumed to have caused the decomposition of the hornblende and felspar, forming calcite with any lime liberated.

The magnetite of the syenite, chiefly derived from the decomposition af the hornblende, has sometimes not been altered, but generally it is represented by limonite, hæmatite, and pyrites. It seems quite possible that the whole of the iron existing in the breccia as sulphide may have been derived from the syenite, the amount of this rock from which almost all the iron has been leached being very large. In this connection reference may be made to the fact that the syenite in the breccia is usually fairly well mineralised, while it is the exception to find any sulphides in mudrock from the same part.

If the pipe was formed by volcanic forces, as assumed, the evolution of sulpheretted hydrogen would be a positive accessory, and thus the sulphur in the ore might be accounted for.

Arsenic may have been introduced into the breccia by ascending alkaline solutions, or it and bismuth may have been derived from hornblende in the syenite (Sandberger).

The syenite may have been the source also of the gold and silver, those metals occurring chiefly near it, though that may be due to the iron from the syenite having caused precipitation.

It has not been proved whether the veins in syenite are of the same age as the pipe deposit or not.

Order of Deposition of Minerals in Breccia.—Quartz appears to have been the first mineral deposited in the shattered pipe, as perfect crystals are found in the other minerals.

Mispickel was the first metallic mineral both in the breccia and syenite fissures. It exhibits a tendency to form coatings on the syenite, but otherwise is well crystallised. The mineral has been designated mispickel for convenience, but the amount of sulphur present is not large, and probably investigation would prove it to be lollingite (the diarsenide of iron).

Bismuthinite was next thrown down in the breccia, and chiefly among mispickel crystals.

Bismuthinite is not evident in the syenite fissures, but instead there are well developed tetrahedral crystals of zincblende. Blende was reported by Mr. Rands from the upper levels, and is now to be seen in breccia at Richardson's winze on the 210-feet level.

A mixture of silicates and carbonates of lime, magnesia, alumina, and iron (including coupholite, a variety of prehnite) has completely cemented the above minerals, and the calcite crystallises in rhombohedra with curved faces when any cavities have been left.

Gold occurs in the breccia in the free state as comparatively coarse grains which, however, are few and far between, and then only in the shoot which has been followed down by tributers from the 200-feet level on the footwall. Almost the whole of the gold occurs in sulphides, in greatest abundance in the same shoot.

WORKINGS.

The main workings of Mount Shamrock consist of an open-cut which originally reached from the surface to a depth of 250 feet. It has, however, been blocked at 85 feet depth by fragments of rock falling on the timbers above the 100-feet level, and again by a big fall at about 170 feet depth.

At the surface the opening is 40 feet long by 15 feet wide, with its length about north and south; at the 100-feet level it is 35 by 25 feet, and it rapidly increases to 50 feet in length above the second fall of rock. Under this again a chamber of considerable size has been excavated—the dimensions will be found on reference to the plans and sections.

Below the chamber stoping has been carried down to the 250-feet level, which connects by winzes with the 300-feet level. One of these—the Long Winze—leaves the open-cut at 40 feet below the 100-feet level, following down the breccia on the east side of the syenite and mudrock protrusion.

The main shaft, which is 9 by 3 feet, has been sunk in country rock to a depth of 150 feet below the 300-feet workings, at a distance of 180 feet east-north-east of the centre of the open-cut at the surface.

Adits 200 and 285 feet in length have been driven from the hillside on the east to the open-cut at 52 feet and 100 feet depths, and the latter is connected with the shaft. A short crosscut has been put into the breccia, towards the south-east, at 90 feet depth. The 190-feet level runs from the main shaft into the breccia.

Quite a number of drives leave the open-cut between the 200 and 250 feet levels, and there the chief amount of work was done. The 250-feet level is not connected to the main shaft.

On the 300-feet level there is a drive from the shaft and several crosscuts, but scarcely any work has been done beyond opening them.

All the winzes, except the Tributers, which is now being worked, and the shaft, below the 300-feet level, are flooded.

It will be seen from the plans that the workings are chiefly in the north-west corner of the deposit and that the south-eastern wall of the breccia has never been reached on any level.

With reference to the plans and maps annexed, it may be mentioned that nine days were spent in the neighbourhood of Mount Shamrock, five of these being taken to investigate the workings. It would take a much longer period to thoroughly examine the ramifications of the breccia and the complications of the mudrock and syenite country. For almost all the bearings and distances given on the plans I am indebted to Mr. Chapple, the Manager, who gave me every assistance in examining the mine.

Ore Extracted.—A rough calculation of breccia removed from the mine gives the amount as about 275,500 cubic feet. The specific gravity of mudrock is 2·73, but the strongly mineralised portions of the breccia will be much heavier. Assuming then that 13 cubic feet of breccia weigh 1 ton, the above ore should weigh about 21,200 tons. The returns give the total amount of stone crushed as 20,666 tons, which includes the ore from the veins in the syenite. The discrepancy arises from part of the ore having been hand-picked.

A moderate estimate of the amount of ore removed from the present company in driving south-west on the 250-feet level and in sinking the Tributers Winze, fixes it as 5,200 cubic feet or 400 tons. This, the manager tells me, was hand-picked at the face to remove as much as possible of the mudrock. Four or 5 tons of 10 to 19¾ oz. mineralised (sulphide) ore was obtained, the remainder crushing for 16 oz. of free gold and producing 15 tons of concentrates, averaging 5 or 6 oz. Thus the value of that block of ore was 8 or 9 dwt. of gold per ton.

Crushings.

	Tons	cwt.		Oz.	dwt.	gr.		Oz.	dwt.	gr.	
1886 ...	3	5	Trial yielding	20	0	0	free gold				
			Tailings „	1	13	0					
			Total	21	13	0	=	6	13	5	per ton
	12	13	Yielding	70	12	18	=	5	12	12	„ „ @ £3 16s. 6d. per oz.
1887 ...	3,149	0	„	3,346	0	0	=	1	1	6	per ton
1888 } 1889 } ...	8,700	0	„	2,978	5	0	free gold =	0	6	2	„ „
1886 } to 1889 } ...	11,864	0	„	6,416	11	0					
...	8,000	0	Tailings yielding...	8,000	0	0	about				
			Total	14,400	0	0	about =	1	5	0	per ton
1890 ...	3,905	0	Yielding	1,687	14	0					@ £3 19s. 11¼d. per oz.
	250	0	Concentrates yielding								@ £17 10s. 10d. per ton
			Total value ...								£2 12s. 7¾d. „ „
								Oz.	dwt.	gr.	
1891 ...	759	0	Yielding	1,056	0	0	=	1	7	20	„ „ and tailings paid expenses
1892 ...	293	0	„	251	0	0	=	0	17	12	per ton
1893 ... None given											
1894 ... „ „											
1895 ...	85	10	„	83	15	0	=	0	19	14	„ „
	14	0	„	58	0	0	=	4	2	21	„ „
1896 ...	60	13	Tributers yielding	320	14	0	=	5	5	18	„ „
1897 ...	575	0	Yielding	122	9	0	=	0	4	6	„ „
1898 ...	1,789	0	„	272	7	0	free gold				
	45	0	Concentrates yielding	155	17	0					
			Total	428	4	0	=	0	4	19½	„ „
1899 ...	217	17	Yielding	47	4	0					
	7	16	Concentrates yielding	43	4	0					
	107	0	Tailings yielding	7	10	0					
			Total yield	97	18	0	=	0	8	18	„ „
1900 ...	1,105	0	Yielding	59	6	0					@ £3 15s. per oz.
	19	0	Concentrates yielding	109	14	0					@ £4 „ „
			Total yield	169	0	0	=	0	3	1	per ton

Assays.—Fifteen samples were taken by me from various parts of the mine, all from the low-grade ore, as there was no rich available. These samples are of the breccia, not of the "cement" alone. With one exception they are intensely disappointing, traces only of gold and silver being returned, instead of 2 or 3 dwt. expected.

The only sample yielding gold was that from Higgin's Opening on the long winze below the 250-feet level:

Gold	6 dwt. 5 gr. per ton.
Silver	5 „ 13 „ „

The remaining assays are:—North-east wall of open-cut on 100-feet level, yielding:

Gold	a trace per ton.
Silver	11 dwt. 16 gr. per ton.

Long Winze from 140 to 190-feet level yielding:

Gold	a trace per ton.
Silver	1 dwt. 23 gr. per ton.

The 215-feet level and up long winze to 190-feet level, yielding:

Gold	a trace per ton.
Silver	13 dwt. 2 gr. per ton.

Traces of gold and silver are returned for samples collected from the following parts:—South-east corner of open-cut on 75-feet level; door drive on 100-feet level; magazine drive on the 100-feet level; main drive on the 100-feet level; main drive on the 190-feet level; drive on 210-feet level; Felix Hole on 250-feet level; Long Winze to Tributers Winze on 250-feet level; Tributers Winze and drive below the 250-feet level; drive opposite syenite drive on the 300-feet level; and syenite drive and that from which it branches on 300-feet level.

The manager of Mount Shamrock, Mr. Chapple, informed me that the bismuth in the concentrates from the battery seldom ran higher than from 2 to 2½ per cent. Individual specimens of the ore, of course, ran high both in bismuth and gold.

TIMBERING AND MACHINERY.

Scarcely any timbering is used in the mine, as the breccia stands for an almost indefinite time, and the form of the workings relieve it of any very great pressure. Coverings have, however, been erected over the 100, 150, 210, and 250 feet levels. These consist of laths laid on stringers supported by hardwood props 18 inches in diameter, and from 20 to 40 feet in length. No supports are ever used when in country rock, being quite unnecessary.

The shaft has been lightly but sufficiently timbered, and is divided into three compartments—two for hoisting and one for a ladder-way. This ladder-way is seldom used, as the men prefer to go up and down the Long Winze; ladders having been placed in that also.

Hoisting is effected by a whim at the shaft, and, as the buckets are only raised to the 100-feet level and there emptied into trucks, quite a low poppet-head is used.

Special carriages are used in the mine for bringing the buckets from the faces to the shaft and back.

From the shaft the loaded trucks are run out one at a time on an overhead line to the battery ore bins, and there tipped.

The battery consists of 20 head of medium weight hand-fed stampers, and besides the copper tables there are 4 Brown and Stanford Concentrators and a Berdan Pan. Four Frue Vanners had been dismantled lately because erected too low for tailings to be distributed from them. Great trouble is experienced in amalgamation owing to the arsenic and bismuth, so, as a rule, mercury is used in the boxes only, and the pulp is run direct to the concentrators.

A two-barrel chlorination plant erected in 1889 has been dismantled, the ore being unsuitable for the process; the furnace (with flue 200 feet in length for condensing bismuth oxide) erected at the same time is still standing.

[No. 168 of the Geological Survey Publications.]

Price 2s. 6d.]

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INDEX

- Alluvium
- Dolerite & Basic tuffs
- Amygdaloidal Andesite
- Slates
- Granite

GEOLOGICAL MAP

No. 1

SHEWING ROUGHLY

THE OCCURRENCE OF THE VOLCANIC ROCKS

IN THE VICINITY OF STONY AND TARWAH CREEKS

To accompany Report on the Stanton Harcourt Diggings and Mount Shamrock Mine

by

LIONEL C. BALL B.E.

Assistant Government Geologist

1901

Scale 20 Chains to 1 Inch

20 15 10 5 0 20 40

H.W. FOX LITH.

STANTON HARCOURT RUN

DEGILBO RUN

STANTON HARCOURT RANGE

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GEOLOGICAL SKETCH MAP

No 2

OF THE COUNTRY IN THE VICINITY OF MOUNT SHAMROCK

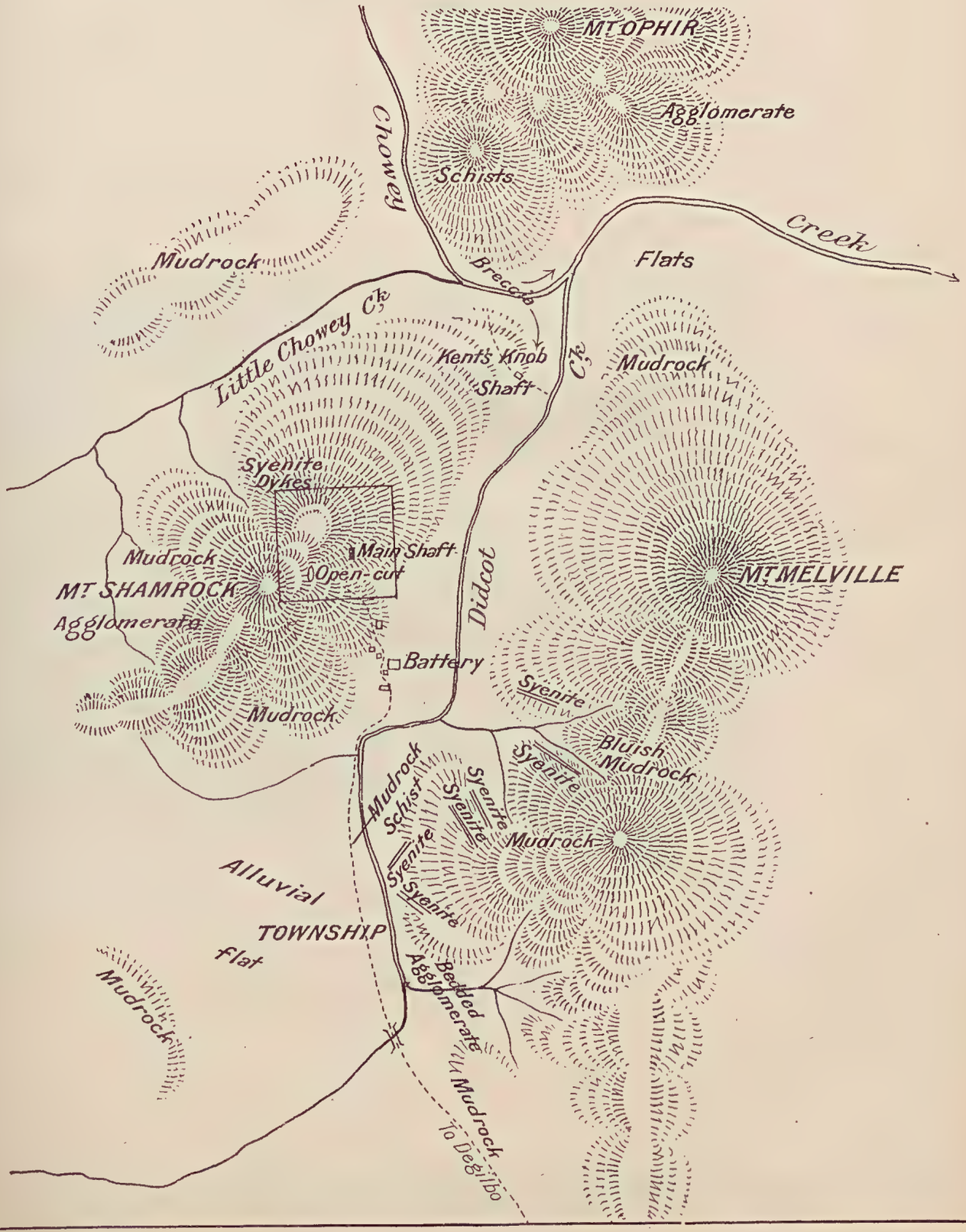
Scale 200 yds to an Inch

To accompany Report on the Stanton Harcourt Diggings and Mount Shamrock Mine

by

Lionel C. Ball B.E.
Assistant Government Geologist

1901



MOUNT SHAMROCK MINE

PLAN OF

UNDERGROUND WORKINGS SHOWING RELATION OF THE SURFACE (BROKEN LINES) & 52 FT LEVEL WORKINGS TO THE SHAFT

Scale 30 feet to an Inch

To accompany Report on the Stanton Harcourt Diggings and Mount Shamrock Mine

by

Lionel C. Ball B.E.
Assistant Government Geologist

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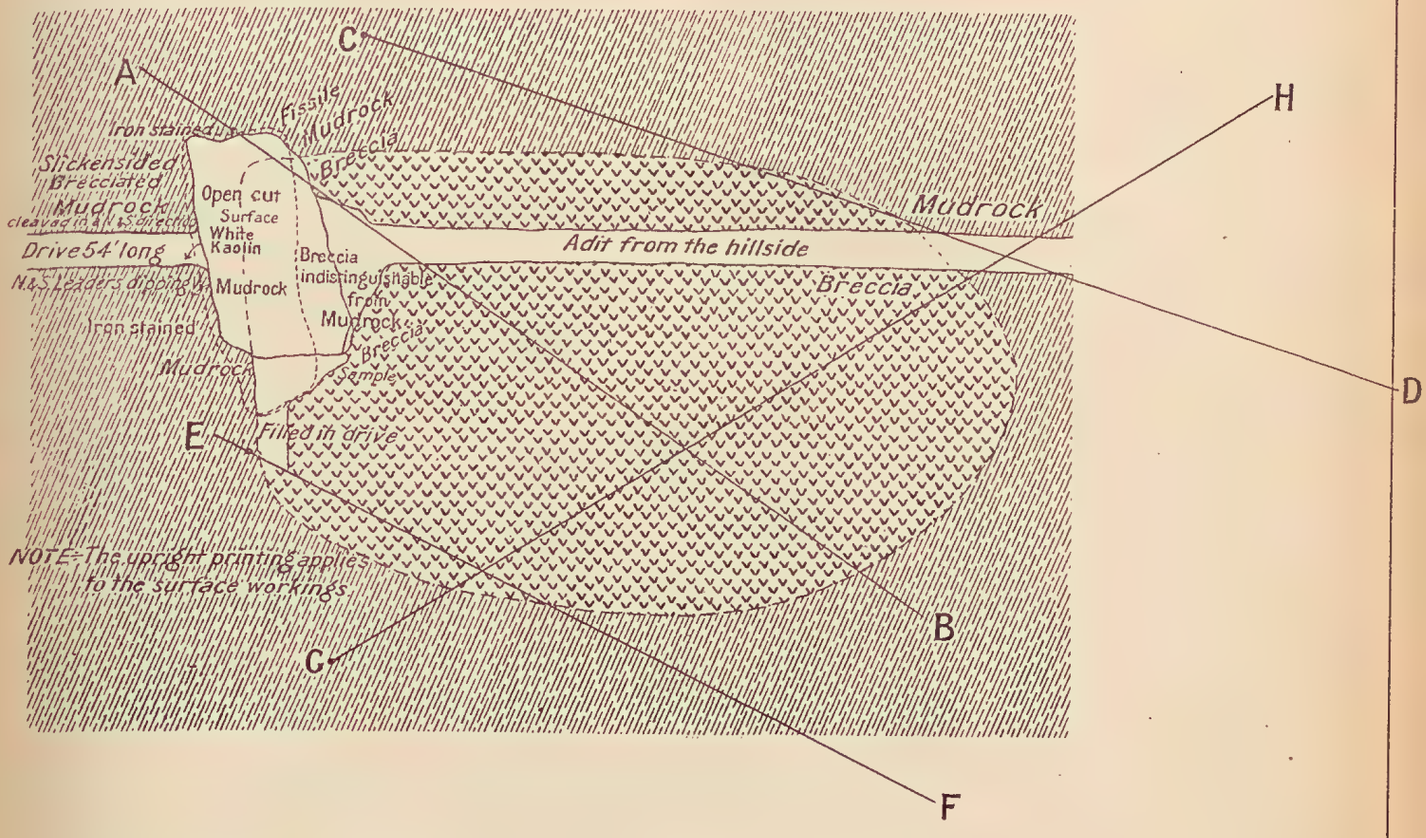
Main



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TIONAL

MOUNT SHAMROCK MINE

PLAN OF UNDERGROUND WORKINGS

AT THE 80 Ft LEVEL (FULL LINES) & THE 90 Ft LEVEL (BROKEN LINES)

Scale 30 feet to an Inch

To accompany Report on the Stanton Harcourt Diggings
and Mount Shamrock Mine
by
Lionel C. Ball B.E.
Assistant Government Geologist
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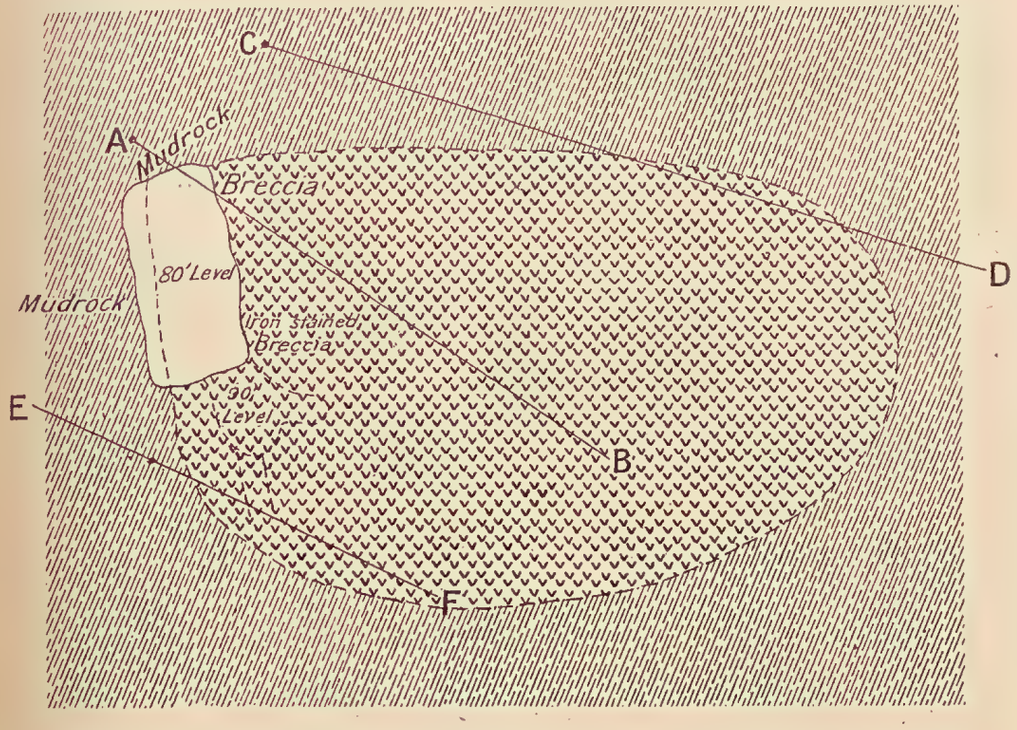
Main Shaft



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MOUNT SHAMROCK MINE

PLAN OF

UNDERGROUND WORKINGS ON THE 100 Ft LEVEL

Scale 30 feet to an Inch

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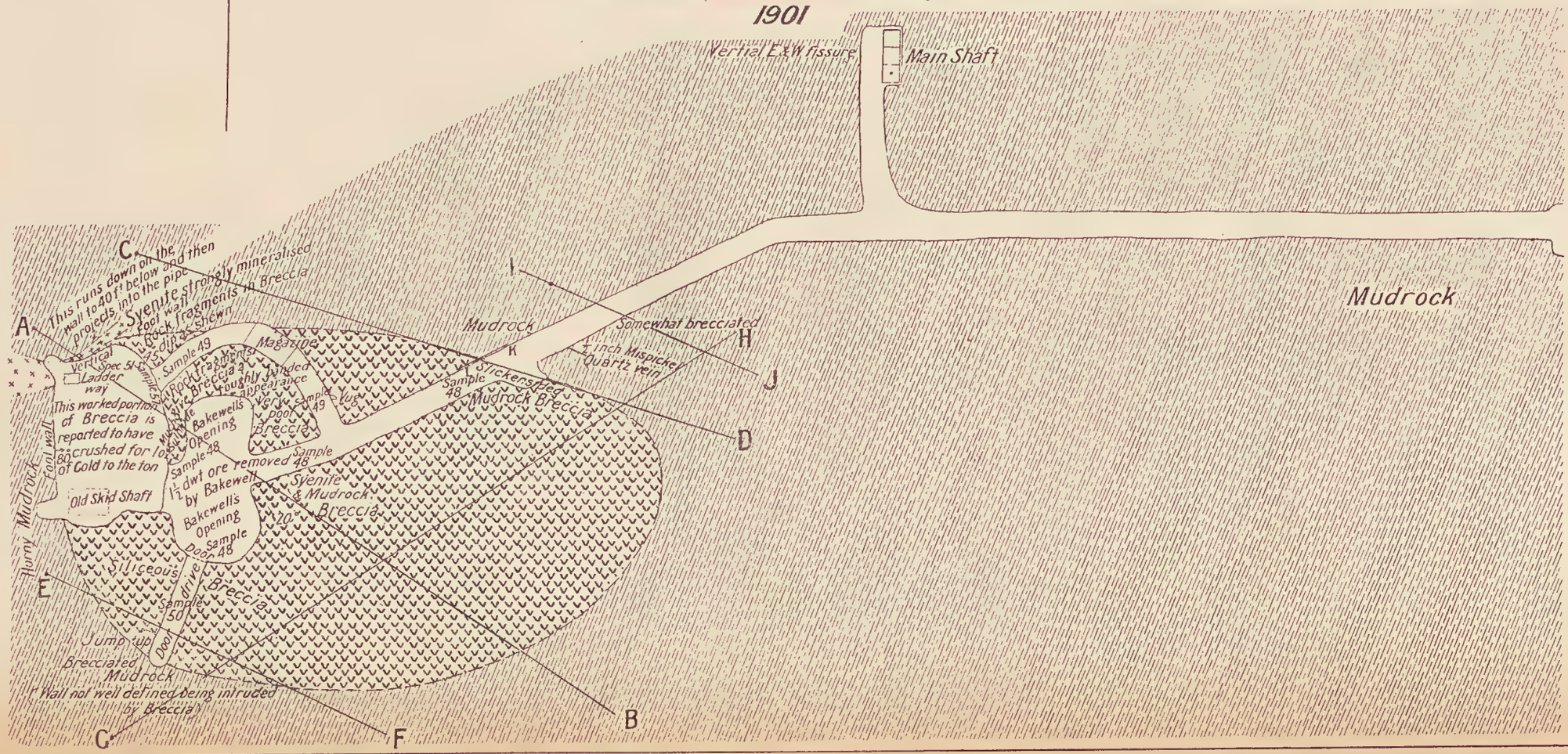

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MOUNT SHAMROCK MINE

PLANS OF

UNDERGROUND WORKINGS

AT THE 150 Ft LEVEL (FIG. 1) & THE 215 Ft LEVEL (FIG. 2)

Scale 30 feet to an Inch

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Lionel C. Ball B.E.
Assistant Government Geologist

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Main Shaft

FIG. 1

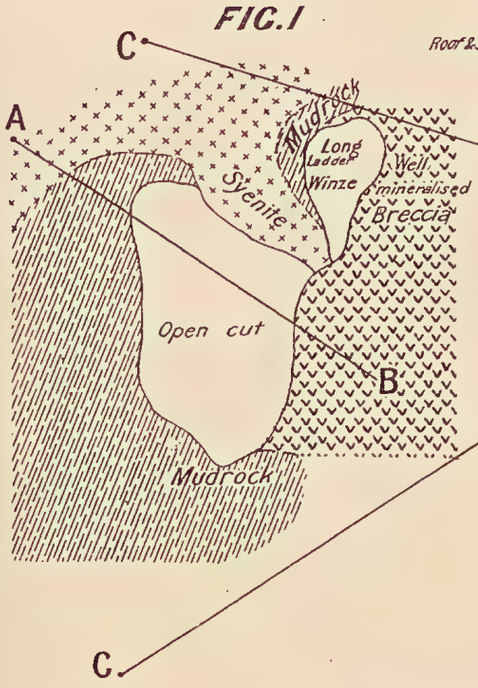
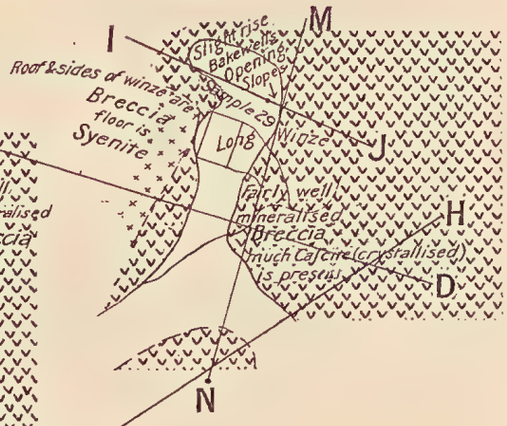


FIG. 2



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NATIO
A

MOUNT SHAMROCK MINE

PLANS OF

UNDERGROUND WORKINGS ON THE 190 Ft LEVEL (FIG 1) THE PROSPECTING DRIVE ON THE 230 Ft LEVEL (FIG 2) THE TRIBUTERS LEVEL 30 Ft BELOW THE 250 Ft LEVEL (FIG 3) & THE CHAMBER 20 Ft ABOVE THE 300 Ft LEVEL (FIG 4)

Scale 30 feet to an Inch

To accompany Report on the Stanton Harcourt Diggings and Mount Shamrock Mine

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Lionel C. Ball B.E.
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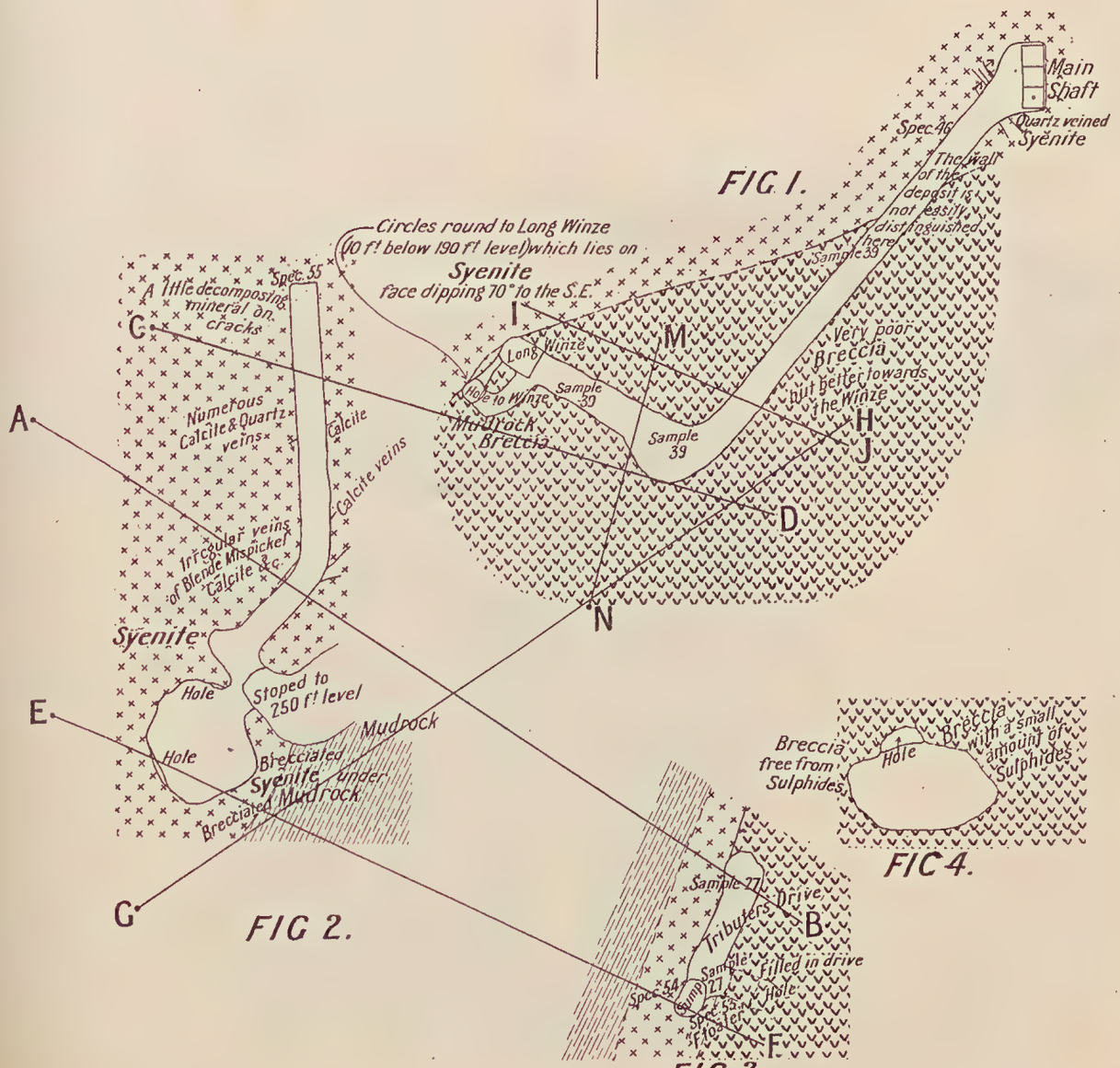

MOUNT SHAMROCK MINE

PLANS OF

UNDERGROUND WORKINGS ABOUT THE 200 FT LEVEL (FIG 1)

& HIGGINS' OPENING UNDER THE 250 FT LEVEL (FIG 2)

Scale 30 feet to an Inch

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Main Shaft

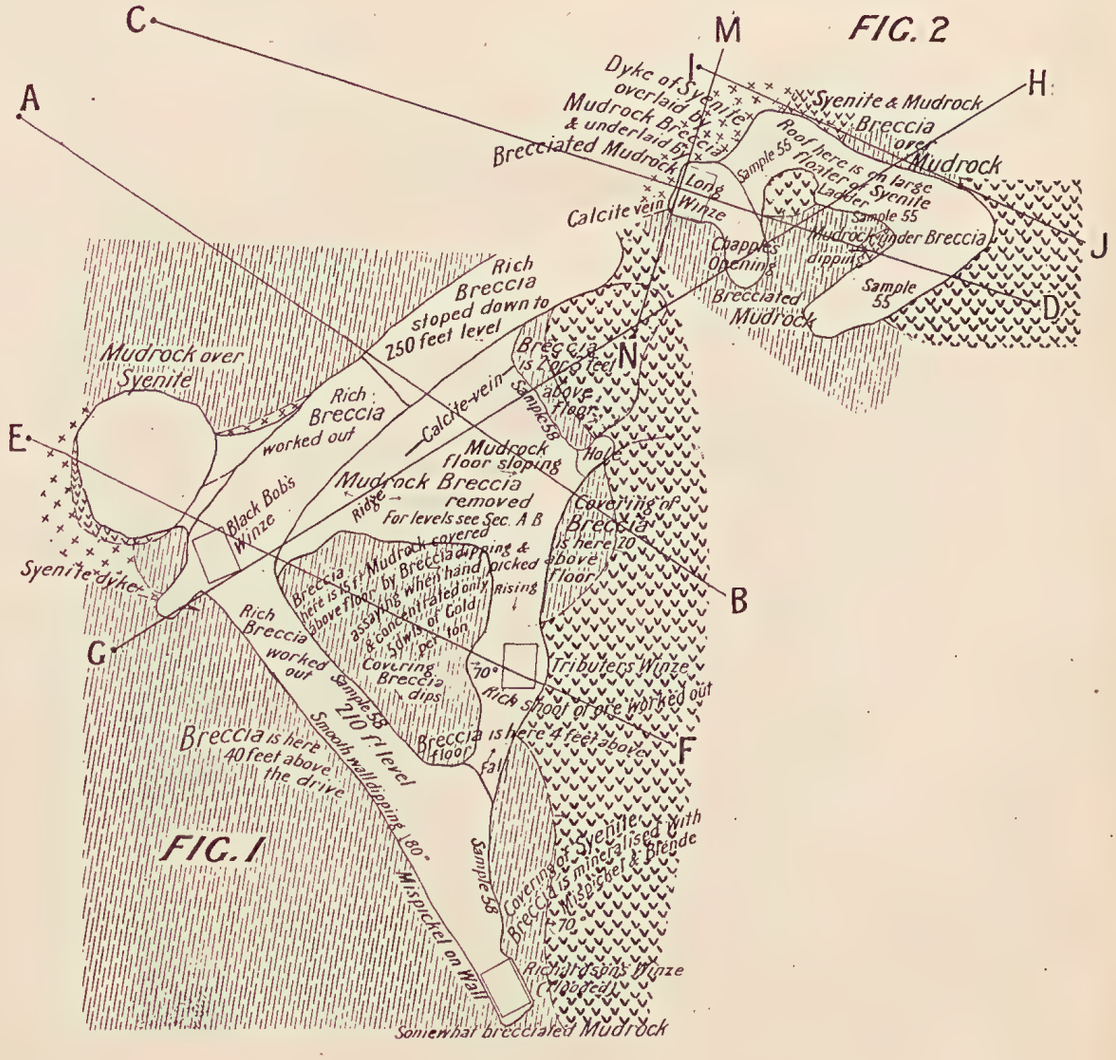

FIG. 1

FIG. 2

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MOUNT SHAMROCK MINE

PLAN OF

UNDERGROUND WORKINGS ON THE 250 Ft LEVEL

Scale 30 feet to an Inch

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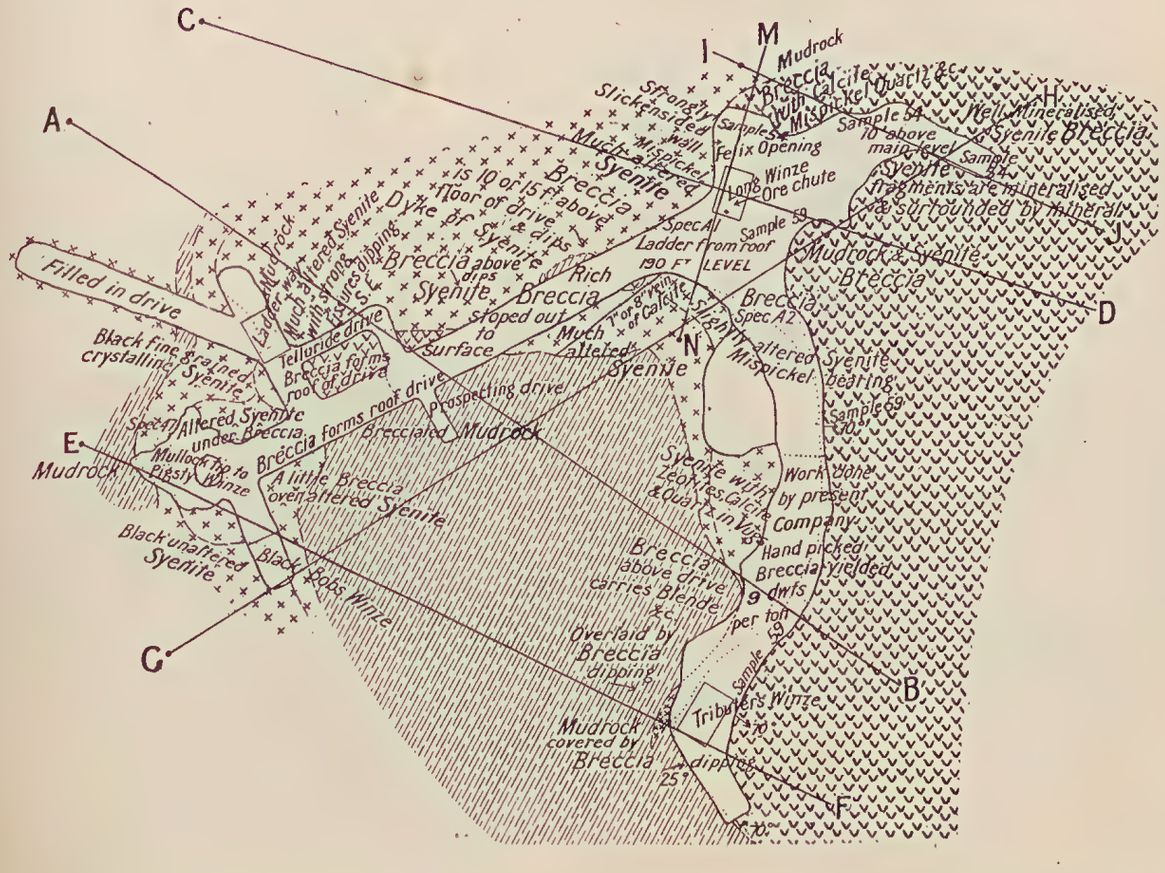
Main Shaft



MOUNT SHAMROCK MINE

PLAN OF

UNDERGROUND WORKINGS ON THE 300 Ft LEVEL

Scale 30 feet to an Inch

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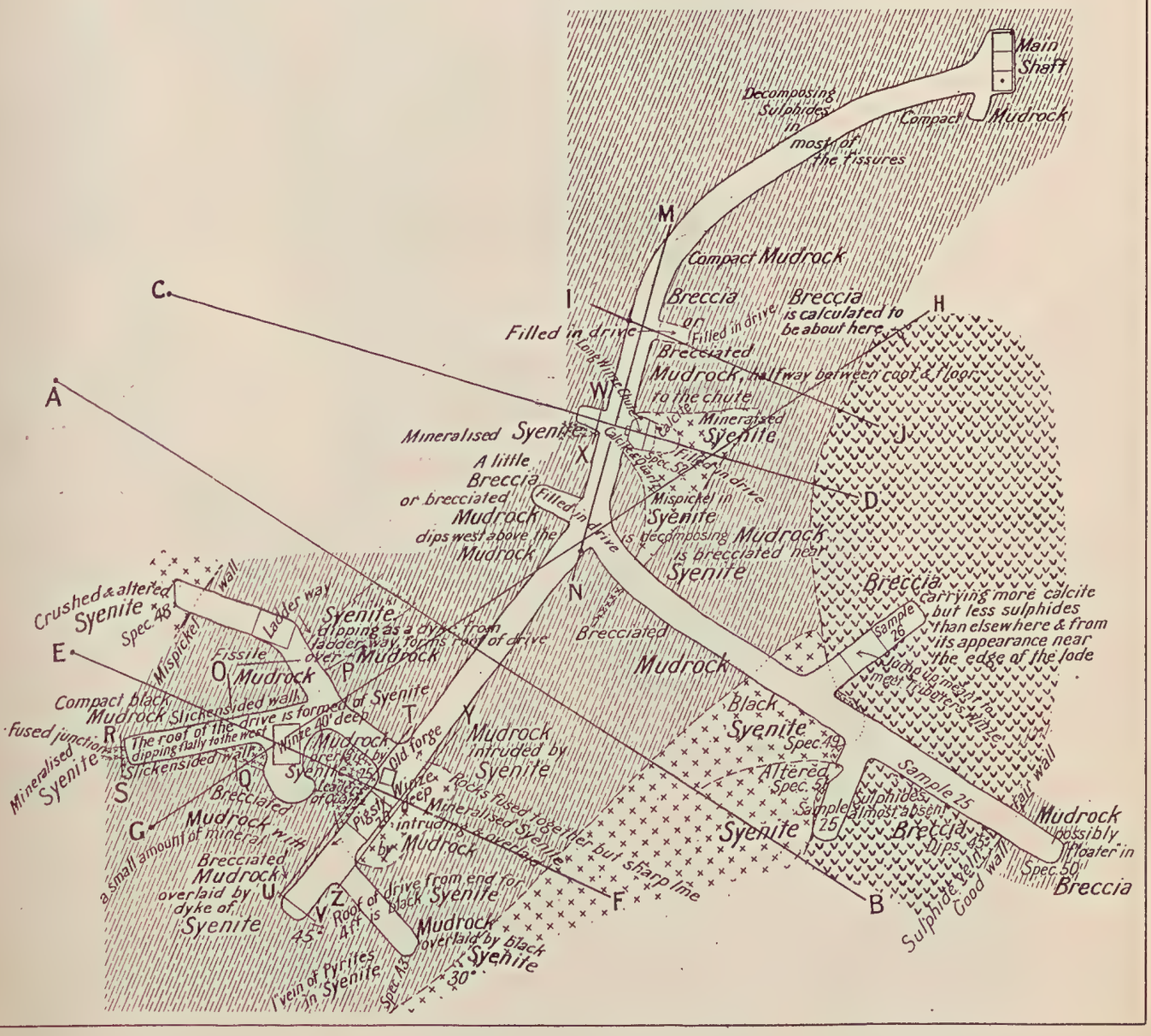

MOUNT SHAMROCK MINE

UNDERGROUND WORKINGS

SECTION ON THE LINE A B

Scale 30 feet to an Inch

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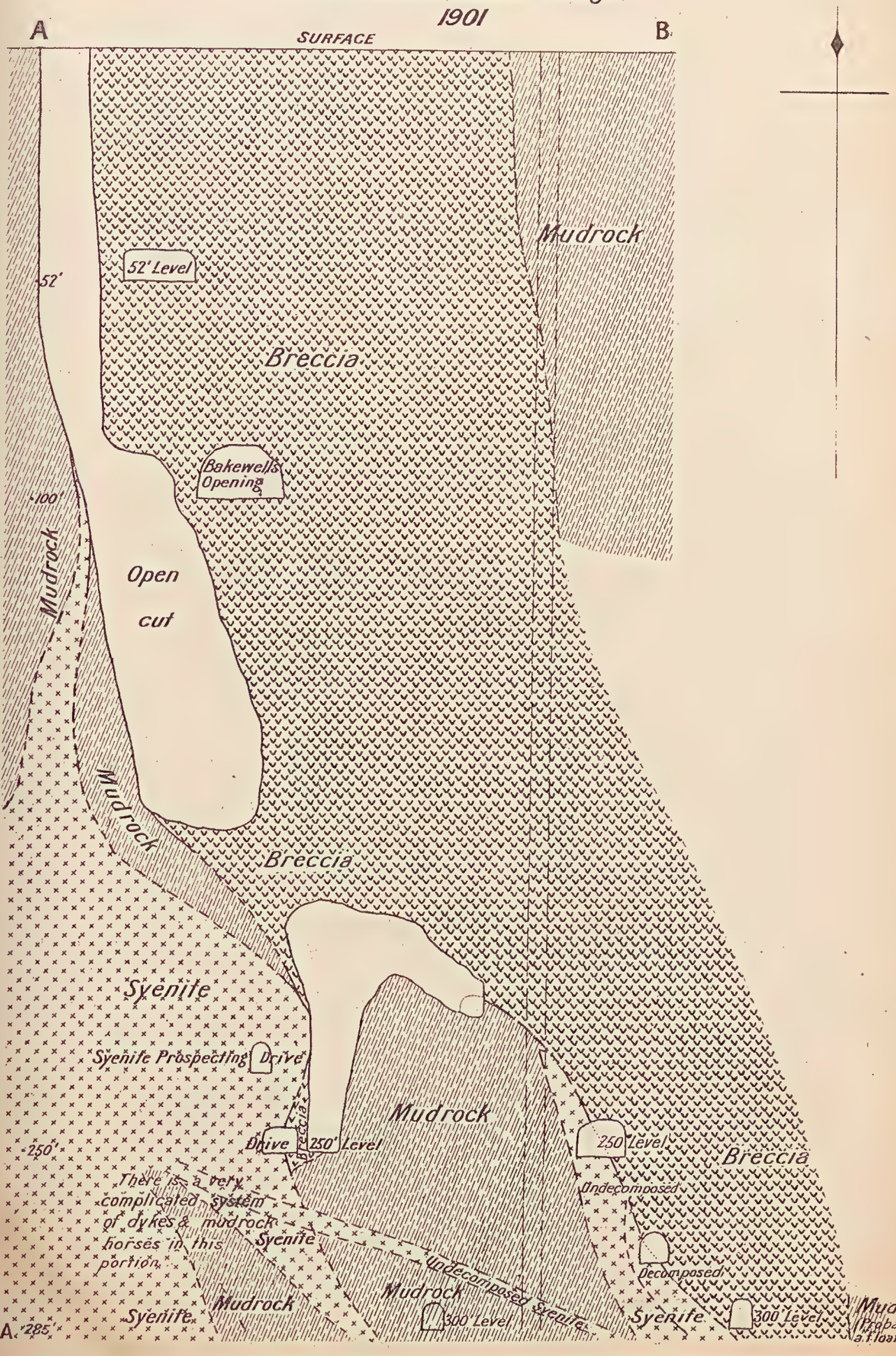

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MOUNT SHAMROCK MINE

UNDERGROUND WORKINGS

SECTION ON THE LINE C D

Scale 30 feet to an Inch

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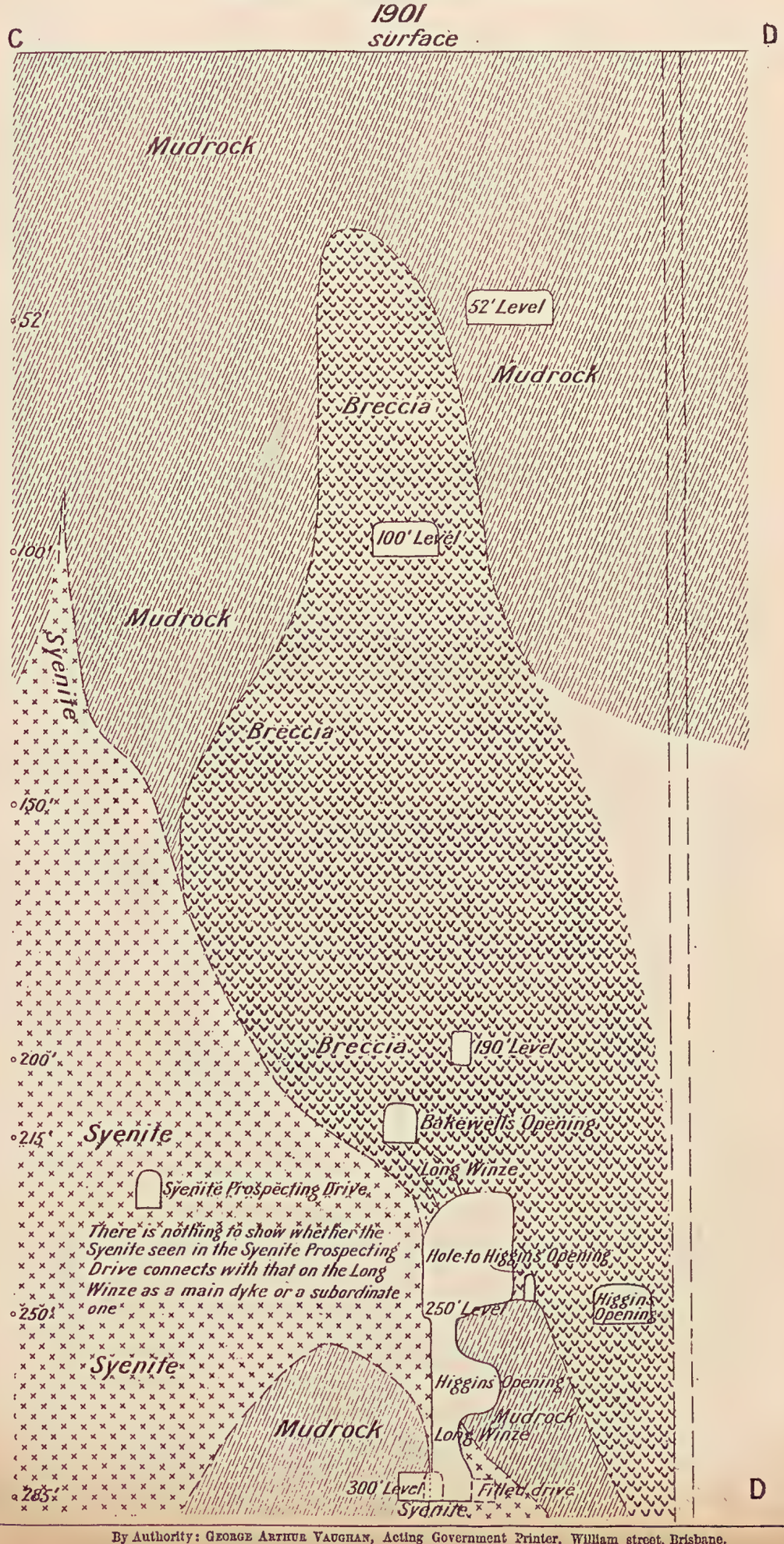

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MOUNT SHAMROCK MINE

UNDERGROUND WORKINGS

SECTION ON THE LINE E F

Scale 30 feet to an Inch

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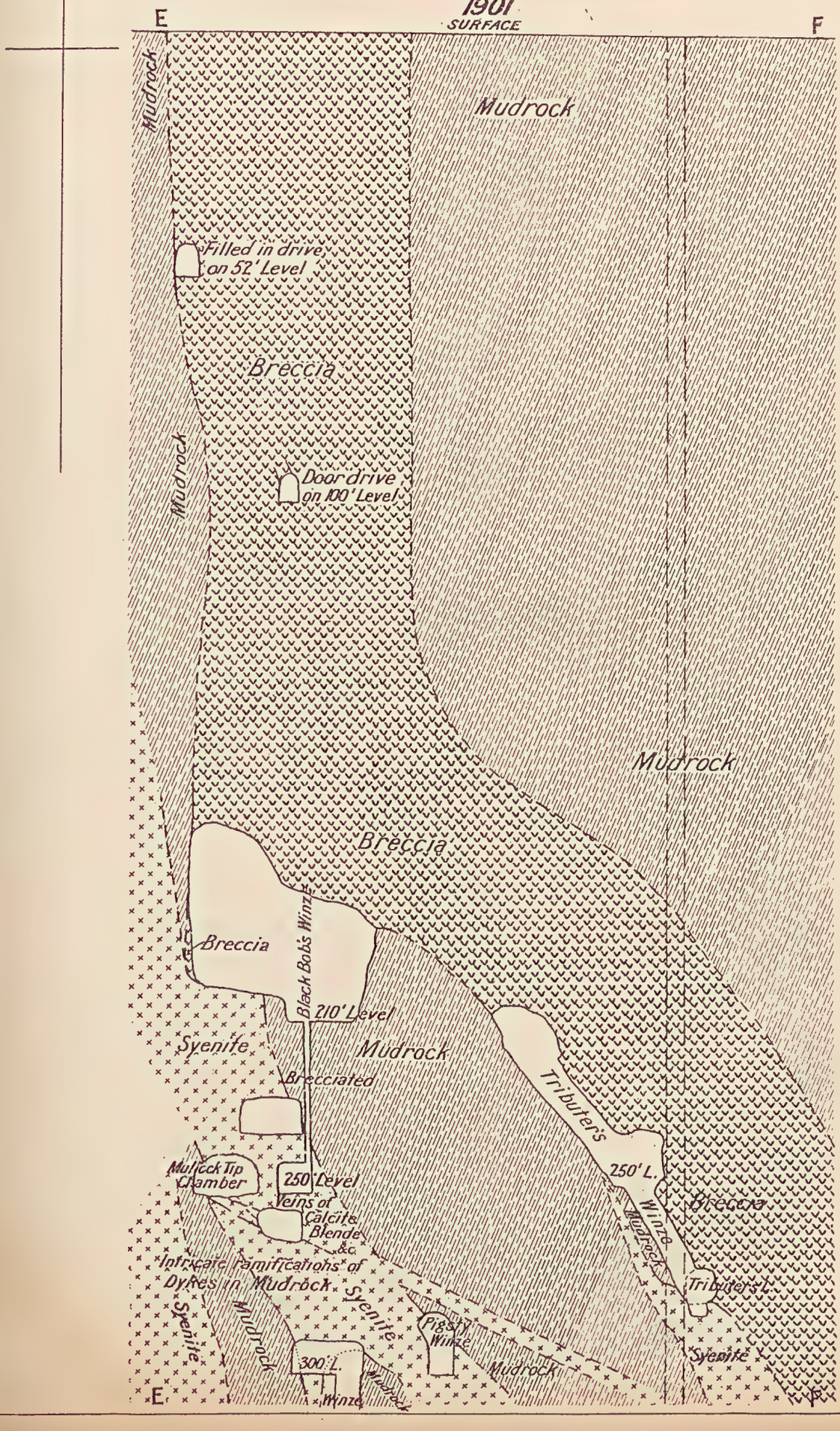

MOUNT SHAMROCK MINE

UNDERGROUND WORKINGS

SECTION ON THE LINE G H

Scale 30 feet to an Inch

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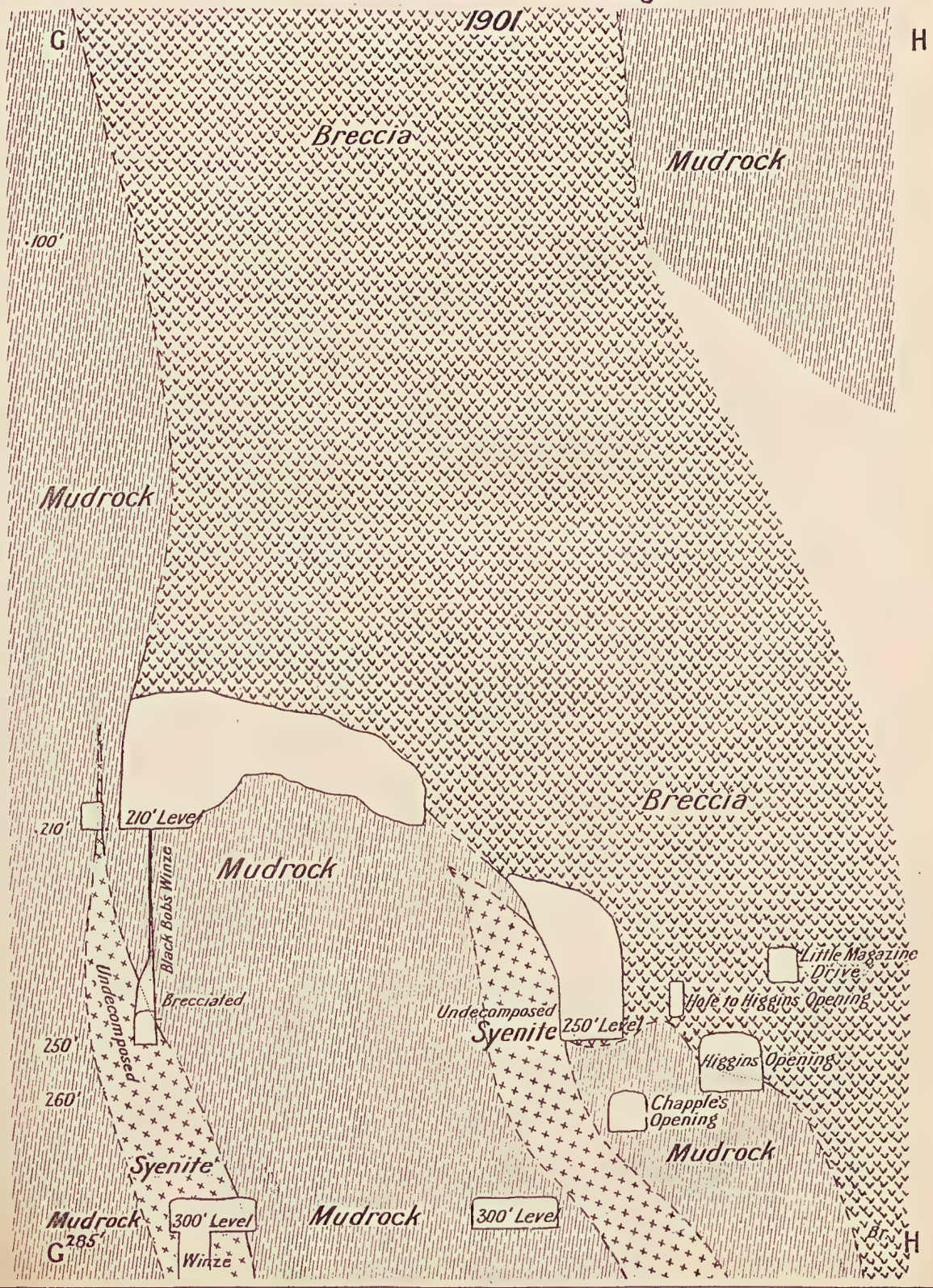

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MOUNT SHAMROCK MINE

UNDERGROUND WORKINGS

SECTION ON THE LINE I J

Scale 30 feet to an Inch

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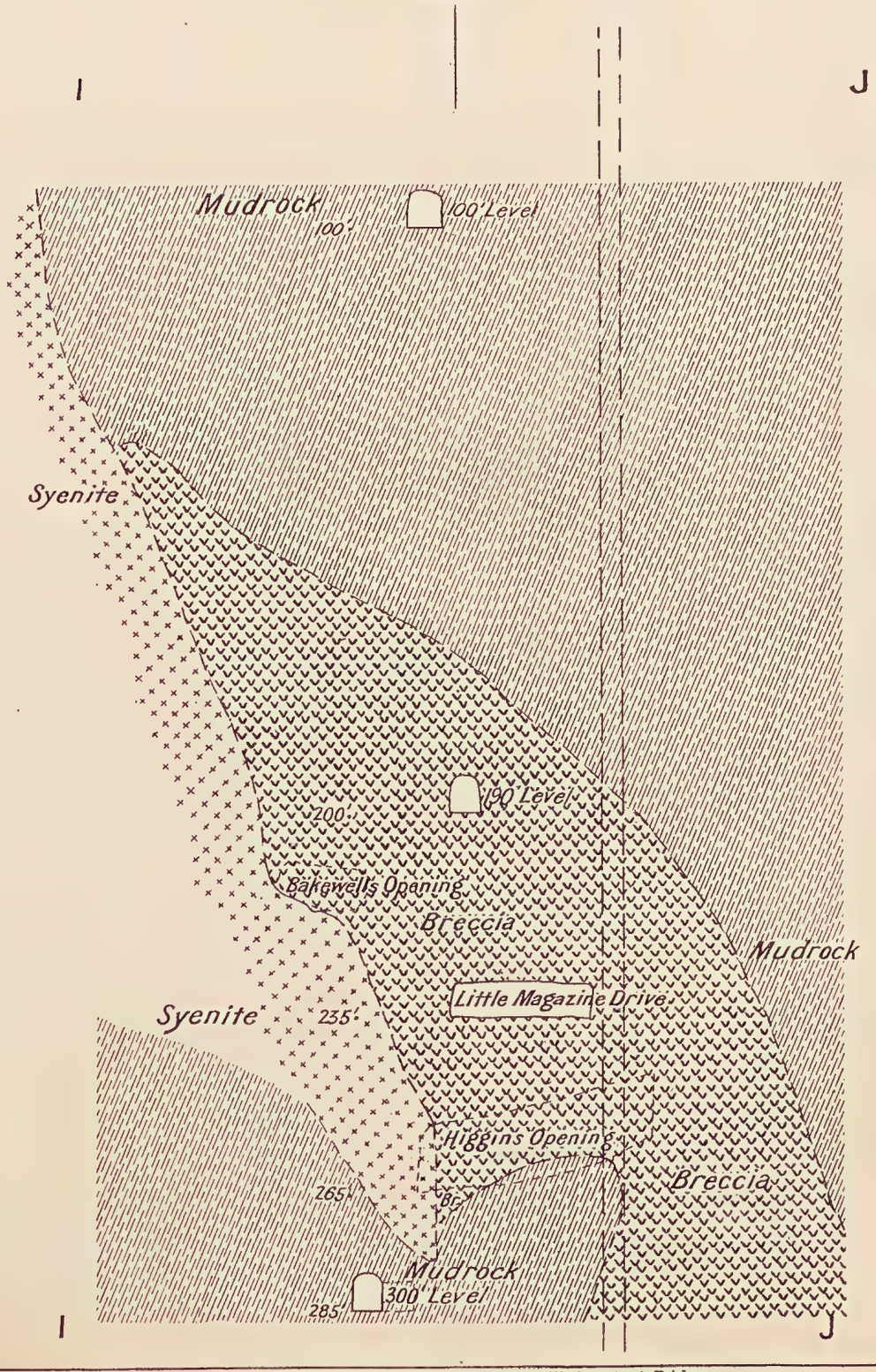
by
Lionel C. Ball B.E.
Assistant Government Geologist

1901



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NATIONAL MUSEUM VICTORIA

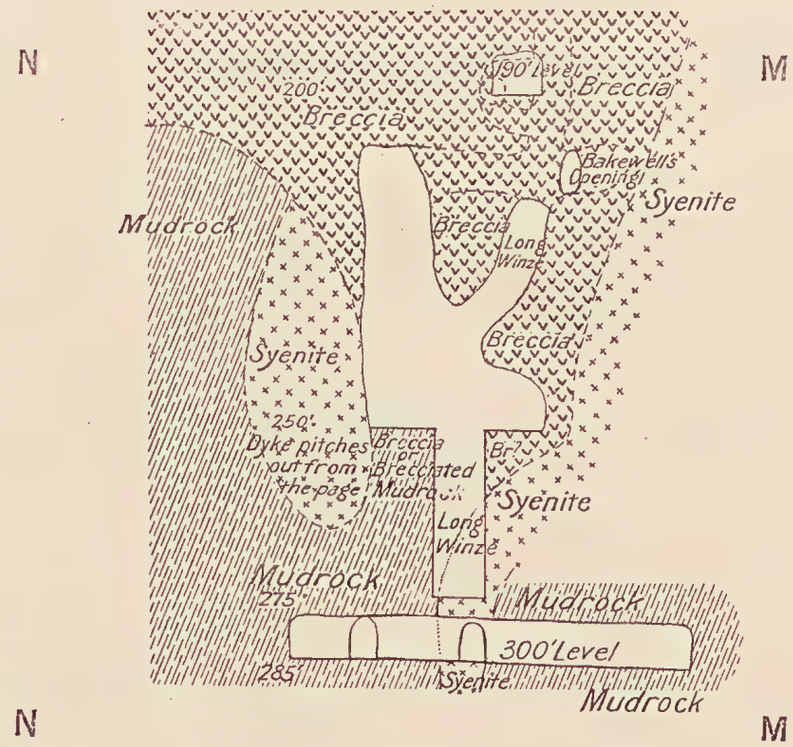
MOUNT SHAMROCK MINE

UNDERGROUND WORKINGS

SECTION ON THE LINE N M

Scale 30 feet to an Inch

To accompany Report on the Stanton Harcourt Diggings and Mount Shamrock Mine
by
Lionel C. Ball B.E.
Assistant Government Geologist
1901



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MOUNT SHAMROCK MINE

SECTIONS ON THE LINES L K Z Y V U U T Q O O P S R X W

Scale 10 feet to an Inch

To accompany Report on the Stanton Harcourt Diggings and Mount Shamrock Mine

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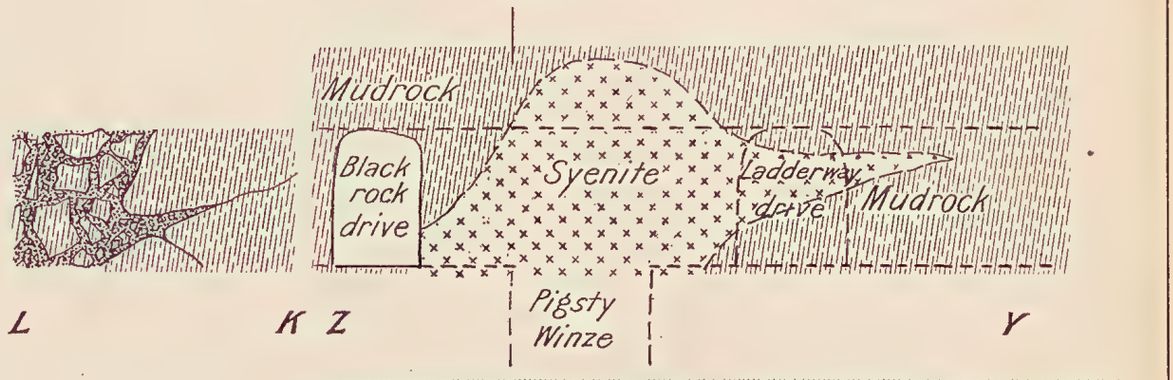

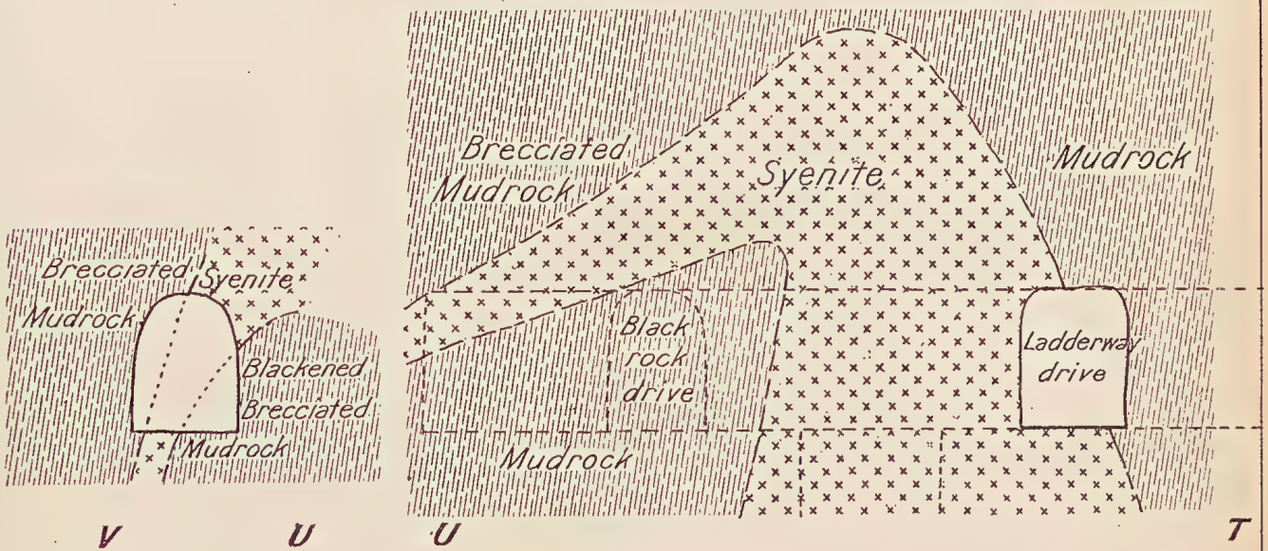

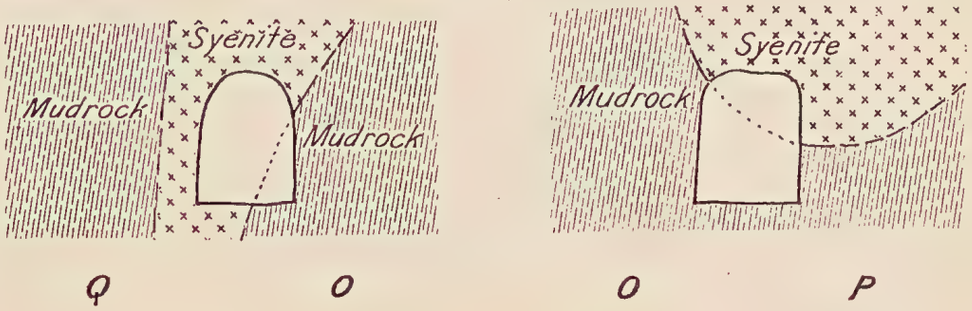

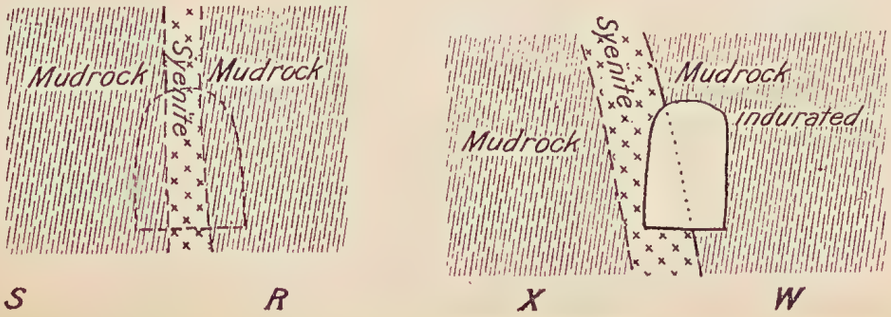

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QUEENSLAND.

SOME MINES AND MINERAL DEPOSITS AT THE HEADS OF THE BRISBANE, BURNETT, AND MARY RIVERS.

(REPORT ON, BY C. F. V. JACKSON, ASSISTANT GOVERNMENT GEOLOGIST).

[*With 5 Plates.*]

Presented to both Houses of Parliament by Command.

THE HONOURABLE THE MINISTER FOR MINES, BRISBANE.

Geological Survey Office,
Brisbane, 25th October, 1901.

SIR,—I have the honour to forward herewith a Report on Some Mines and Mineral Deposits at the Heads of the Brisbane, Burnett, and Mary Rivers, by Mr. C. F. V. Jackson, Assistant Government Geologist.

I have, &c.,
WILLIAM H. RANDS,
Government Geologist.

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INTRODUCTION.

The series of reports herein grouped under a general title for publication have each from time to time been provisionally issued to the various mining companies interested.

The properties described are nearly all on the Main Range, which divides the watersheds of the Brisbane, Burnett, and Mary Rivers, an area which, on the State Geological Map, is shown to be occupied by a series of rocks of the Gympie Formation (Permo-Carboniferous). There is also within the area a belt of granitic rocks which trends in a north-westerly direction, and has a length of 70 miles with a mean width of 8 or 10 miles.

The mineral deposits are all either in the Permo-Carboniferous Area, or in or near the outer margin of the granitic rocks, and in the majority of cases they are situated on old mining fields, where speculators are venturing on exploitation at a greater depth than that attempted by the original prospectors. In only one or two instances has any record been preserved of the early output and history of these old fields.

THE SILVER-LEAD DEPOSIT AT MONSILDALE.

The Monsildale Mine is situated in a direct line 45 miles north-west of Caboolture, and 36 miles north of Esk. It is accessible from either of these places, the road distance being some 10 or 12 miles greater.

The route, *viâ* Caboolture, follows the Esk Coach Road as far as Hopetoun, and thence to the top of the Main Range, a well-used bush track. The maximum aneroid reading, where the road crosses the range, is 1,200 feet above Caboolture, with a short, steep ascent for the last 200 feet, the whole of which is accomplished at a grade of somewhat less than 1 in 5. After leaving the summit there is scarcely a track of any kind, and owing to the number of creek crossings the journey is extremely rough. With the exception, however, of the steep ascent of the range a serviceable road without excessive grades could easily be found. A better approach is said to be obtainable from Esk, but I was not able to examine this route.

Plate I. shows more exactly the position of the mine, in the parish of Monsildale, portion 46. The property consists of two prospecting areas of 80 acres each, and the east and west boundary lines are shown in their approximate positions.

Silver was discovered at Monsildale some fifteen or twenty years ago, and the deposit worked until 1893 by a former owner of the station. The present owners obtained possession of the property and reopened the workings in 1894, and carried on operations for about five years; the upper levels were extended and the lode prospected at a lower level, but beyond that required to retain possession no work has been done for the last eighteen months. The mine is on the eastern slope of a high spur, and is about 420 feet above Monsildale Creek, which drains the surrounding country. This creek is subject to floods at certain periods, and for a time becomes a raging torrent transporting large masses of rock. The average rainfall for the district is 51·4 inches, and during the dry season the creek is practically dry-bedded, though it is said that water can always be obtained by sinking a short distance into the sand.

In the vicinity of the deposit there are, roughly, two main geological areas; of these the most northerly consists of a coarse granite with veins of aplite which stretches from Woodford on the south to and beyond Manumbar Station on the north.

The other is occupied entirely by more or less metamorphosed sedimentary rocks, which are represented on the Geological Map of Queensland to be of Permo-Carboniferous Age belonging to the Gympie Formation.

The deposit occurs in the altered rocks close to their junction with the granite on the north; there is very little surface indication of an outcrop, but by means of trenches and holes it has been traced for some distance east of the mine. The prominent feature of the lode is the main ore-body, which occurs near the centre of the deposit. It has a fairly constant width of 3 feet, and its strike is 5 degrees south of west; its dip is at right angles thereto towards the south, the angle of inclination being 68 degrees.

The remainder of the filling on either side consists of crushed and broken country which is much slickensided, the breaks and joints being filled with a greasy clay. Running through this "Formation," as it is termed by the miners, are small veins of calcite from 1 to 1½ inches in thickness, and there are also strings and veinlets of iron pyrites and galena.

Fig. 1.

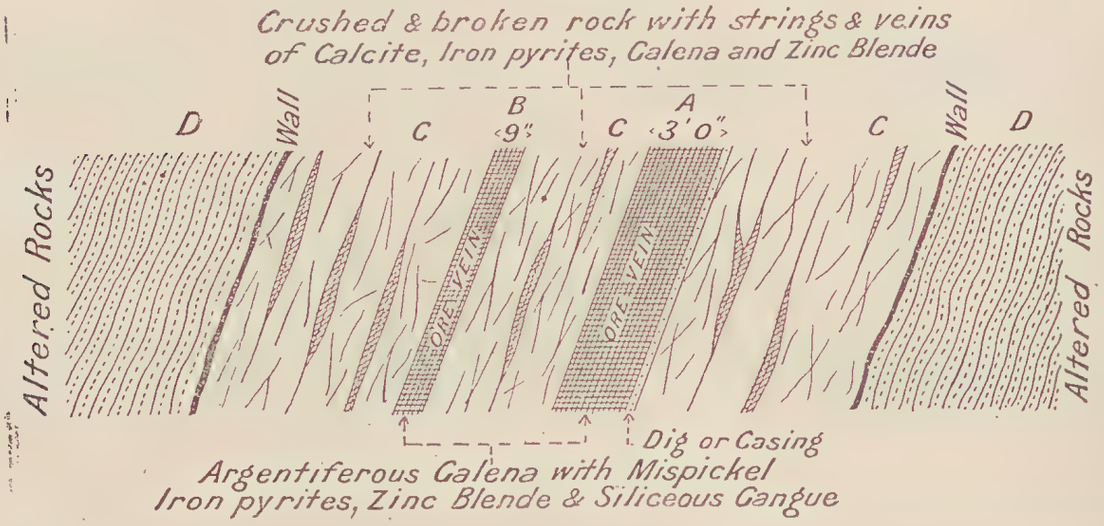


Fig. 1 shows a section of the lode at the lower or 70-feet level, where there is another smaller 9-inch ore vein to be seen.

The total width between solid walls is variable, but at the upper levels, where it is measurable, the distance is about 33 feet. The workings at the lower level have pierced the broken country.

The ore consists of a rather fine-grained argentiferous galena with zincblende frequently intermixed, and the gangue, which contains some calcite, is very siliceous. It is remarkable that but little oxidized ore has ever been obtained.

The sulphide ore has often a compact and granular structure, when it is difficult to distinguish the zincblende from galena.

The silver, no doubt, occurs partly in one mineral, and partly in the other. Galena is always argentiferous, and the silver commonly appears either as isomorphous sulphide, or as a finely disseminated silver mineral, *e.g.*, tetrahedrite. The difference of form is important in connection with wet concentration, the former being more favourable to the process.

Besides galena and zincblende the ore contains as accessary minerals some iron pyrites and a considerable amount of mispickel, but I did not note the presence of any tetrahedrite. Associated zincblende does not generally contain as much silver as the galena.

Gold is present in the ore, probably in the iron pyrites and mispickel, and also to some extent in the galena.

The first work of the earlier prospectors at Monsildale consisted of sinking a shallow shaft close to the summit of the hill above the present workings, and later a small tunnel was driven some 20 feet lower down. Neither of these works can be inspected, as they have long been abandoned and have become filled up.

The existing tunnel was next driven some distance lower down the slope on the footwall side and approximately parallel to the course of the lode. This tunnel was continued for a distance of about 140 feet, curving slightly towards the end to intersect the ore vein (see Plate I.), and at about 100 feet there was also a short drive turning in a northerly direction. The mine at this stage was abandoned, and, being put poorly timbered, practically the whole of the workings had soon either fallen in or required retimbering.

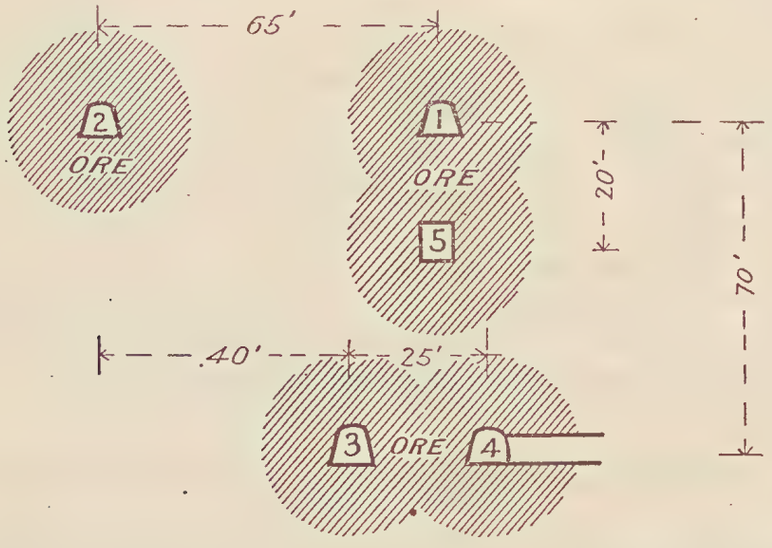
Such was the condition of prospecting operations when the ground was taken up by the present owners, who cleared the old workings and extended operations by driving in a westerly direction. (See Plate I.) The drive was not parallel to the course of the main ore vein, but this was reached by crosscutting at 70 feet.

Attention was next turned to prospecting at a lower level by sinking vertically on the hanging-wall side of the main vein, some 8 or 10 feet from the point where it was intersected by the original tunnel. The shaft passed through the ore at 20 feet, and was continued for 70 feet, when the deposit was opened up by workings similar to those of the upper level.

At the time of my visit the lower levels had not been entered for some considerable time, and it was not possible to thoroughly explore their southern and eastern extent.

The whole of the work above described has resulted in the ore deposit being pierced in five places, where it was possible to take samples for assay, thus (see Fig. 2) :—

Fig. 2.



As far as can be actually seen, the valuable portions of the lode consist of the two ore veins, the gold, silver, and lead contents of which are stated in the assay table below; and though the same table shows the average contents of the whole of the formation on either side to be but little more than a trace of gold and silver, it is quite probable that some minor portions of it may be rich enough for concentrating.

Table of Results of Assays.

Description and Position.	Gold per ton.	Silver per ton.	Average Lead per cent.
	Oz. dwt. gr.	Oz. dwt. gr.	
A, Vein Upper Level (1)	1 4 20	18 14 9	4·2
„ „ (2)	0 9 3	6 9 21	
„ Lower Vein (3)	0 3 18	3 13 0	3·5
„ „ average (4)	0 7 0	14 18 19	
B, Vein Lower Level (3)	0 3 22	2 14 6	Not determined
Formation Upper Level, average	0 0 18	1 3 3	Trace only
„ Lower Level „	Trace only	0 2 14	Trace

The highest return of gold was obtained from the upper level—viz., 1 oz. 4 dwt. 20 gr., and from the above results it would appear that the ore is rather poorer in gold and silver at the lower level; nevertheless, one sample which was taken in the short easterly drive at the bottom of the winze contained the highest percentage both of silver and lead, yielding 19 oz. of silver and 5·58 per cent. of lead, but only 1 dwt. 23 gr. of gold per ton.

There is evidently a rich shoot of ore in this drive, and it is to be regretted that it was not possible to obtain samples from its eastern limit.

The question whether the lode is likely to be permanent in depth is one of considerable importance. The broken and slickensided country on either side of the ore vein, and the fact that it is dipping away from the crystalline rocks might be regarded as evidence in favour of a deep fissure. The ore body is fully as wide at the lower as at the upper levels, and though its productiveness as given by an average assay would seem to be somewhat less, it has already been mentioned that the richest silver specimens were taken from the lower levels.

Whatever the probabilities may be, the work carried out so far has not revealed any sign of want of permanence of the deposit.

Surface prospecting has been carried out, and several shallow shafts sunk on the property, and some copper ores are said to have been found some distance to the north-east, but I was not able to visit the locality.

At about 200 yards to the north-east there is an old shaft about 80 feet deep, and from the material taken out and lying on the surface there appeared to have been a vein of galena and blende about 4 inches wide. It is possible from its position that this is part of the main deposit, but it was not possible to descend the shaft.

A picked sample from a portion of this 4-inch vein, which, of course, does not represent its average value, yielded silver 18 oz. 4 dwt. 4 gr. per ton; and gold, a trace only. The ore was very zinciferous.

With regard to the quality of the ore of the main deposit samples were taken over the whole width of the ore vein, and the assays represent the average value for a thickness of 3 feet; if a smaller width had been taken the results would no doubt have been higher, as the vein is generally richer on the hanging-wall side.

Assays have also shown that the average silver contents are not high, while the amount of lead is decidedly low, no sample giving more than 5·5 per cent.

Besides silver and lead the ore contains a little gold, which adds to its value.

The following analysis gives the silica, zinc, arsenic, and sulphur contained in the ore:—

Silica and Insoluble	61·96 per cent.
Arsenic (metal)	3·30 „
Sulphur	9·11 „
Zinc	7·20 „

The above results represent an average value for the vein throughout the whole of the workings; but the ore, if anything, contains more mispickel and iron pyrites at the lower than at the upper levels, and is certainly more zinciferous.

The presence of blende and arsenic is objectionable for metallurgical reasons; they prolong roasting and cause losses of silver by volatilisation, the latter may also impair the quality of the lead, and it is the custom of smelting companies to make an extra charge of 1s. per unit for ores containing over 5 per cent. of arsenic.

The gangue is very siliceous, and the ore is not adapted for complete reduction at the mine, which the cost of fuel, &c., would probably render impracticable in any case. If further development warrant the stoping of the ore and the extraction of its valuable constituents, probably some form of partial treatment would be most advisable, such as preliminary grading followed by crushing and concentration.

A richer product could then be exported to the smelting works, where the common deficiencies in lead, &c., of such ores can be supplied when making up the smelting charge.

THE RISING STAR, NORTH STAR, AND GREAT PYRAMID PROSPECTING AREAS, PARISH OF BIARRA.

In accordance with instructions, I visited Esk on the 20th May to inspect and report on prospecting operations for copper ores at the Rising Star, North Star, and Great Pyramid Prospecting Areas, parish of Biarra.

The Rising Star and North Star.

The Rising Star and North Star are adjoining properties, situated about 12 miles north of Esk, those of the Great Pyramid lying about 2 miles to the south and west therefrom. Both are accessible from Esk by a good road without excessive gradients, though the deposits themselves are in very mountainous country.

The relative position of the Rising Star and North Star Areas is shown on Plate II., which shows also the position of the principal workings and the boundaries.

The first mining operations at the Rising Star consists of a shaft sunk by some Melbourne investors in 1872. This was abandoned owing, it is said, to the unsatisfactory state of the copper market.

The Rising Star Copper Mine Syndicate applied for and were granted their prospecting area on the 30th May, 1899, having started work during the previous month in the old shaft. The syndicate have since continued prospecting, and recently obtained assistance from the Government to drive a tunnel at a lower level. (See Sketch Plan, Plate II.) This tunnel has now reached 104 feet.

The North Star Copper-mining Syndicate obtained the adjoining prospecting area in July, 1899, and have carried on work continuously with from two to four men.

The upper workings of the Rising Star are about 400 feet above Cressbrook Creek, which drains the surrounding country, and affords a permanent water supply, the average rainfall of the district being 51·4 inches.

Broadly speaking, the country in the immediate vicinity of the mine consists of a series of sedimentary rocks, broken into and altered by intrusions of a basic crystalline rock. Rocks of sedimentary origin are seen in all stages of alteration—from coarse, almost unaltered conglomerate to rocks so highly metamorphosed that without microscopic examination it is impossible to separate them from rocks of igneous origin, and hence without extended geological observations to trace the relation of the various formations of the locality.

The general direction of the intrusions or dykes appears to be about north-west, and with a parallel strike small outcrops of the oxidised products of copper are to be seen. These outcrops occur chiefly in the altered sedimentary rocks, or at their junction with the intrusive rocks. When followed down they dip at a high angle to the west.

The ore occurs chiefly in the form of strings and veinlets of the yellow sulphide (copper pyrites) inclined at a high angle and generally striking in a north-westerly direction, the same mineral being also found to some extent disseminated through the country rock.

Associated with the copper pyrites, which is frequently highly irridescent, are found iron pyrites, zincblende, and galena in small quantities. I saw no bornite or other rich redeposition minerals.

The zone of surface oxidation extends only to a small depth, and no trace of the oxidised ores seen at the surface is visible in the workings at a depth of 50 feet.

It appears probable from the general appearance of the veins that copper-bearing solutions may have made their way along the original planes of bedding of the sedimentary rocks, and thence by cross fractures to the surface.

In a previous report Mr. Dunstan noted the occurrence of tuffs, which may form part of the series herein classed under the general term of altered sedimentary rocks.

He also advanced the theory that copper originally existing in these rocks has been segregated out, and has ultimately impregnated the rocks and formed as veins in the joints and cracks.

The subject of the occurrence of copper in tuffs and shales received a good deal of attention from Professor David in 1887, in a paper entitled, "Cupriferous Tuffs of the Passage Beds between the Triassic Hawkesbury Series and the Permo-Carboniferous Coal Measures of New South Wales," read before the Australasian Association for the Advancement of Science, and there is no doubt that the widely disseminated nature of the copper deposits at Biarra, and the fact that but little more than traces of copper minerals are found in the intrusive rocks, is in favour of the suggestion.

The upper or principal workings of the Rising Star are on the slope of a mountain which rises to a height of 900 feet above the creek; here a shaft has been sunk about 15 feet on the dip side of a small vein, which is cut at a depth of 20 feet.

It was then proposed to follow this vein with an inclined shaft, but after going a few feet it was decided to continue the straight shaft to a depth of 50 feet. At this level workings were opened out in a south-east and north-west direction.

A small vein running in a south-east direction was met with in a crosscut at about 25 feet from the shaft, and driven along for about 20 feet, when it was lost, a fault plane being followed, under the impression that it was one of the walls. (I was not able to thoroughly examine this drive, as it is now abandoned and filled with mullock.)

The workings were subsequently extended in a south-westerly direction, and a number of veinlets varying from a film up to a little more than half-an-inch width were cut; these are of ordinary copper pyrites.

At 20 feet the films and veins became more concentrated in the country rock, and form a small low-grade ore body having a width of 2 feet 3 inches. The ore is of good quality, and a sample yielded 3·75 per cent. of copper, also 1 oz. 13 dwt. 23 gr. of silver per ton; and gold, a trace only. Nothing further was met with for 50 feet.*

I think it would have been advisable to have carried on further prospecting, in order to gain further knowledge as to the extent of the ore in those workings.

The tunnel, however, previously mentioned, which is being driven about 4 chains to the south-east, may ultimately accomplish the purpose; but the distance to go and the amount of dead work are very considerable. This tunnel is roughly 100 feet below the upper workings, and would therefore have to be extended considerably more than twice its length to cut the vein if it continues down. It passes through both the altered sedimentary and intrusive rock, disseminated zincblende and copper pyrites being seen in the former.

Generally speaking, the Rising Star Mine is still in a prospecting condition; no large ore body has yet been met with, and the extent of the workings does not furnish evidence which would permit of any predictions being made with regard to veins of greater dimensions being found by further prospecting.

The principal workings of the North Star are about three chains north of the Rising Star, and close to the boundary of the two properties. The work done here consists of a tunnel driven 63 feet in a north-westerly direction along the strike of a small vein, which was either not followed or not continuous. Copper ores were again found at the end of the drive, and an inclined winze commenced but abandoned after a few feet of sinking.

In addition a shaft has been sunk through altered sedimentary rocks a little to the west of the tunnel mouth. This was continued for 36 feet, and at that level a drive put in 40 feet in a north-westerly direction.

I was not able to inspect this shaft and drive, but it was hoped by their means to cut the vein lost in the tunnel at a lower level. No important results were obtained.

Nothing has been done in these workings since Mr. Dunstan saw the property, and if further work is contemplated the best course would no doubt be to follow the suggestions contained in his report, viz., to continue the winze. I think, however, that further work at this spot would hardly be advisable until there are further developments in the Rising Star adjoining.

The position of the workings at what is known as the Galena Lode is also shown on the sketch plan in the North Star Lease. It is about 15 chains north of the North Star Tunnel. Here there is a shaft sunk in the altered rocks to a depth of 40 feet. A small outcrop of carbonate of copper, with a trace of copper pyrites, led to the sinking of the shaft. Small veins and strings of copper pyrites were cut at an early stage as the work proceeded, which have a strike a few degrees west of north, and are almost vertical.

The shaft appears to have been sunk just to one side of a bunch or group of these viens, which at a depth of about 40 feet formed an ore body at the northern end somewhat similar to that met with in the lower levels of the Rising Star Mine.

It is usually considered advisable to continue sinking on a lode until the water level and zone of yellow sulphide is reached, when richer secondary ores may be expected. The absence of any definite lode formation, and the mode of occurrence of the copper at the Star Leases, combined with the fact that

---

* Note.—Since the description was written samples for assay have been taken from the first 25 feet of this crosscut with the following results:—

		Per cent. Copper.
1st and 2nd, 5 feet	average ...	0·10
3rd, 5 feet	Floor ...	0·25
	Roof ...	3·70
	Sides ...	0·3
4th, 5 feet	Floor ...	0·65
	Roof ...	0·20
	Sides ...	0·67
th 5 feet	Floor ...	0·30
	Roof ...	0·05
	Sides ...	0·05

the copper pyrites is so close to the surface, does not lead to expectations of richer ores such as bornite, copper glance, &c., at a greater depth; and future prospects must depend on persistent search for larger ore bodies of the same class as those which have already been met with.

The position of the Galena Lode Shaft is such that opening out in an easterly direction will probably be the course adopted, but I think the wisest plan would be to continue sinking for some distance further before doing so.

A small vein of galena is to be seen about two chains from this shaft, and there are several other outcrops of carbonate of copper on the Rising Star Lease, but none are more promising than those which are now being prospected, and to which operations will no doubt be confined.

With regard to the character of the ore in other respects, the presence of zincblende has already been noted, and the absence of any appreciable quantity of iron; but it is difficult to form a definite opinion as to its value for treatment without complete chemical examination. It must not be forgotten, however, that the class of ore most likely to be met with is such as would need preliminary dressing or concentration before metallurgical treatment.

The Great Pyramid Copper and Silver Mining Company.

The property of this company consists of four adjoining areas of 160 acres, situated about 2 miles south-west of the Rising Star Mine.

Crossing the intervening country, granitic rocks are seen about half-way between the two mines, and then large outcrops of felsite; some of these latter rocks are extremely fine-grained, and exhibit in hand specimens some marked characteristics of the rhyolytes. Examples of an interesting variety of rocks are to be seen in the bed of Cressbrook Creek, such as granites, porphyries, slates, conglomerates, breccias, &c.

Some galena is said to have been picked up on the Pyramid Areas in 1895, but the first record of copper ores seems to have been early in 1898. Mining work was started in October of the same year. A considerable amount of surface prospecting has been carried on since, but a good deal of it has been misdirected and expended at too many points. I think that the most promising outcrop is that known as the "Pyramid"; and I would recommend that for the present operations be confined to pushing on the work of sinking at this spot, which is the most elevated working on the property and situated about 950 feet above the creek.

When I saw the Pyramid Shaft it had been sunk vertically 18 feet, and 4 feet at an angle of about 45 degrees to follow the dip of the ore formation.

The Pyramid Outcrop bears about 10 degrees west of north, and just above the shaft some specimens of epidote and limonite were obtained.

The copper ores to be seen at the surface consist chiefly of blue and green carbonate, a little silicate, and there is also a white mineral, probably a zeolite.

The formation containing them (broken and decomposed country rock) has a width of about 12 inches at the outcrop, and widens considerably at the bottom of the shaft; I have since been informed that with further sinking the prospects have improved.

The enclosing rocks are altered and brecciated, and the outcrop is close to the junction of the altered rocks, and an intrusive rock—a "trachyte"—which forms the summit of the hill above the shaft. Here, as at the Star Mines, the copper occurs chiefly in the altered sedimentary rocks, and the outcrops are universally close to an intrusion.

The other work done in the upper or westerly portion of the company's property consists of a tunnel driven 140 feet, bearing west 10 degrees south, and at a point about 550 feet above the creek or 400 feet below the Pyramid Outcrop.

This tunnel passed through hard intrusive rock which showed here and there strings of copper pyrites, but it was being driven at a ruinous cost, and was abandoned. Its direction is nearly at right angles to the course of the Pyramid Ore Deposit, which it may have been the intention to intercept at this level, but as a method of opening up the deposit it was certainly premature.

An outcrop known as the "Lord Roberts" is situated near the centre of the property, about 400 feet above the creek; here copper is seen, chiefly in the form of carbonate, filling cracks and joint planes in the altered sedimentary rocks; the latter are brecciated by small dykes of trachyte, and a larger intrusive mass of this rock lies about 2 chains to the east. Some "native copper" is said to have been found at this outcrop, and the country rock is much stained by films of both blue and green carbonate. Some further prospecting might well be done here when the work of sinking the Pyramid Shaft is more advanced.

About 10 or 12 chains to the east, and 150 feet lower down there is another small outcrop which has been called the "Mountain Maid." The work done consists of a tunnel driven about 20 feet in a westerly direction. Small strings of copper pyrites were met with, which, I was informed, assayed several pennyweights of gold. There can have been little inducement to continue driving, and the work was advisedly abandoned.

Near the south-east corner of the central block there is an outcrop of partly decomposed felsite, much stained by oxide of iron, which is known as the "Iron Duke," and while surface prospecting was being carried on some work was expended at this spot, amounting to a small tunnel 20 feet in length, and a trench 20 feet by 6 feet; there was, however, no encouragement to proceed.

The Saxon Shaft has been sunk near the eastern boundary of the leases, close to the bank of Cressbrook Creek. A felsitic rock lies to the east, and the altered sedimentary rocks to the west; the shaft is partly in breccia.

The depth reached was 53 feet, the first 10 feet being vertical, and the remainder inclined. A little galena, iron pyrites, zincblende, chalcopyrite, and melaconite were met with. The outcrop here was but a mere film of carbonate of copper, and there cannot have been much inducement to sink the shaft, which is in a bad place and required a considerable amount of bailing to keep it free from water. Owing to the dense scrub a complete examination of the area is difficult, but I saw several places where the surface had been cleared to expose small outcrops. At all these places the rocks are much stained by carbonates and oxidised products of copper; but as mere traces of these minerals characteristically colour large outcrops of rocks, these superficial colourings have frequently been delusive.

GOLD NEAR MILFORD ROCKS HEAD STATION.

Milford Rocks Head Station is situated about 23 miles north-west of Esk.

The existence of gold in this neighbourhood appears to have been known for a good many years, and some alluvial has been obtained from several of the creeks.

Milford Rocks Station is about 8½ miles north-west of Eskdale Station, and approaching it from the latter there is a rise of about 300 feet; the country passed over consists entirely of granite, a large area of which stretches to the north-west and north for many miles, its southern boundary being immediately south of Eskdale.

In the vicinity of Milford Rocks Station the country consits of schists and quartzites, &c., intersected by dykes and tongues of granite; and a few miles to the north there is a small area of sedimentary rocks mapped on the Geological Map of Queensland as belonging to the Gympie Formation.

Gold is found in small veins which are most probably seggregation veins, and which occur in the granite or in the altered rocks near the junction, being at right angles thereto.

In the station paddock, a few yards in front of the house, one of these veins has been sunk on to a depth of 6 or 8 feet, and has been followed horizontally for about the same distance.

This vein is on the southern edge of a dyke of granite, being almost vertical, and where exposed it has a width of from ½ an inch to 2 inches. There are also several other smaller veins in the granite which dip in different directions and carry a little gold, but at this spot no veins have been found so far in the altered rocks adjoining.

It is very improbable that the veins will materially increase in size, and I am of opinion that they are not worth very extensive prospecting; but if further work is contemplated, the best course would probably be to endeavour to follow the vein already in sight by deeper sinking, after which the junction of the granite dyke with the altered rocks could be explored by drives, in search of other veins, which might be found on either side.

About a mile to the north-west there are some similar gold-bearing veins, and here sluicing operations have evidently been carried on by prospectors.

From the amount of work done it seems probable that a good deal of gold must have been obtained, and as far as could be seen the veins were a little larger than those close to the station.

They occur here in the altered rocks on the northern side of the granite dyke, and a dish of quartz and gravel, &c., from the old "Paddock" gave very good results when washed.

Some shallow sinking has been done at one or two other points along the junction of the granite with the altered rocks, but no veins seem to have been exposed.

GYMPIE COPPER MINES LIMITED, GOOROOMJAM CREEK.

The property of the above company consists of 200 acres, situated in the parish of Gallangowan.

The nearest railway terminus is the township of Kilkivan, which lies almost due north at a distance of 30 miles in a direct line, but an extension of the railway is now in course of construction which will reduce the distance considerably.

The present route follows the Nanango Coach Road to Barambah, and leaving it then to the west, takes a south-easterly direction to reach the mines. There are no very steep grades, but the distance is considerably greater than by direct measurement, and for the latter part of the journey the road has not yet been formed.

The mines are situated near the head of Gooroomjam Creek, almost at the summit of one of the spurs of the Main Range, which divides the watersheds of the Burnett and Brisbane Rivers; the elevation is here by aneroid measurement 2,000 feet above sea level, of which about 1,550 feet is accomplished on the journey from Kilkivan.

The total area held by the company is divided into three portions, described as M.L. No. 25 (80 acres), M.L. No. 26 (40 acres), and the P.P. area (80 acres) (see Plate III.), and the property includes the chief portion of the old Scrub Paddock Diggings, which were described in an old report of Mr. Rands as follows:—

"The Scrub Paddock, as its name implies, is a natural paddock completely surrounded by scrub, the only entrances being where the Gooroomjam Creek enters it, and where a road has been cut through the scrub on the way to Gabba Station.

"Nearly all the gold which has up to the present time (1886) been obtained is from two creeks, one of them on the Burnett Falls, known as 'German's Gully' or 'Dry Gully'; the other on the Brisbane Falls, and known as 'Whites,' or Manaramby Creek. The former of these two has proved the richest. Near its head nuggets as high as 13 oz. were obtained, and several from 7 to 9 oz. Lower down again the gold is much finer in size. This gully, which runs into Gooroomjam Creek (a tributary of Barambah Creek), has been worked for about a mile down from its head. In Gooroomjam Creek there are some old workings, but I believe that only a very small amount of gold was obtained from it."

NOTE.—I inspected some of these workings, and at a place known as the Township Flat, where the original miners made their camp, there is an old shaft sunk in some gravel wash, from which I was informed a small diamond had been obtained. Information was even forthcoming with regard to its value and history, but it seems extremely improbable that only one such gem should have been found.

"Rounded pebbles of ironstone (hæmatite) were nearly always found in conjunction with the best patches of alluvial in German's Gully. These pebbles themselves contain gold; an assay of them gave 16 dwt. 8 gr. of gold per ton.

"Manaramby, or White's Creek, has been worked for some 2 miles down from the paddock.

"The gold from these creeks was very pure, its value at the Sydney mint being £4 2s. 6d. per oz.

"The reefs from which this alluvial gold must have come are situated on the summit of the Brisbane Range in the paddock. This area consists almost entirely of fine-grained micaceous diorite. This rock is flanked on the Brisbane side by a grey granite, of which the spurs on either side of Manaramby Creek consist. Below this again, or about 4 miles from the heads, is a series of schists, conglomerates, and shales (the latter in places is so carbonaceous as almost to resemble coal in appearance), which dip steeply at an angle of about 45 degrees, in direction varying from west to west 30 degrees north."

The old diggings seem to have been first worked more than thirty years ago, and subsequently the three existing shafts were sunk at different points on the several reefs, from which, no doubt, by their decomposition and disintegration the alluvial gold of the gullies was derived.

These earlier workings were only continued for a depth of about 100 feet, owing most probably to the quantity of metallic sulphides which soon made their appearance.

A syndicate formed about four years ago, and afterwards registered as the Gooroomjam Copper Mines, No Liability, took over the property, and spent a good deal of money on surface prospecting and further sinking. Several parcels of ore sent to different smelting companies for treatment gave encouraging results, and the present company, the Gympie Copper Mines Limited, was then formed in London.

The shafts have all been re-timbered, and work carried on continuously.

One shaft has been sunk with a whip for nearly 300 feet, which is about the limit of depth with the appliances at the disposal of the company at present; but they propose to obtain winding machinery for any further sinking.

The workings are all on the Northern or Burnett slope of the dividing range, the area being drained by Gooroomjam Creek, and though there is a fair average rainfall, its regularity seems to be very uncertain. The surface configurations of the locality are, however, suitable for water conservation, and I visited several suitable sites which have been suggested for the construction of dams.

Mining Lease No. 25.

The deepest workings, which are situated in the northern portion of the property, M.L. 25, have reached a depth of 290 feet. The shaft here (known as No. 1) passes through a hard diorite containing a rather large proportion of ferro-magnesian constituents and a considerable quantity of magnetite. This diorite extends almost completely across the company's property, and forms the enclosing rock of all the principal ore veins. It is of variable texture, being less coarsely crystalline and also not quite so basic in some places as in others—as the rock at No. 3 Shaft, further to the south, also diorite, contains a smaller percentage of hornblende, &c., and a little quartz generally, for a considerable distance on either side of the vein; the country rock, though still hard, has been much altered and decomposed, probably by hot mineralising solutions, which have also impregnated the walls in many places with iron and copper pyrites, &c. The decomposed rock has the appearance of a light-coloured felsite, which, when weathered and stained by oxide of iron, gives rise to the characteristic yellow-brown outcrop of a number of the ore veins on the property.

The deposit being worked at No. 1 Shaft has been traced for some distance by means of shafts and holes in a direction approximately 35 degrees east of north; this is only a few degrees from the average strike of the veins on the property, which have an average dip towards the south-east of 75 degreees.

Below the surface in No. 1 Shaft drives have been put in at 90 feet, 140 feet, and 225 feet in depth respectively, along the course of a vein, or rather two veins, as a second makes its appearance at the 225-feet level. These two veins have each about the average strike and dip, and the country between them frequently contains a considerable amount of disseminated copper and iron pyrites. The veins are known on the mine as the footwall vein and the hanging-wall vein respectively, which names will be retained herein for no other reason than to prevent confusion. The footwall vein is the one which has been approximately followed by the shaft. The footwall vein is first seen at 90 feet in depth in a short drive about 17 feet 6 inches in length towards the north-east, where there are two veins about 2 feet apart; each is several inches wide, and the surrounding country contains a little copper pyrites.

An average sample representing a vein of about the mean width gave:—

	Oz.	dwt.	gr.	
Gold	1	15	22	per ton,
Silver	3	5	23	per ton,
Copper			5·31	per cent.,

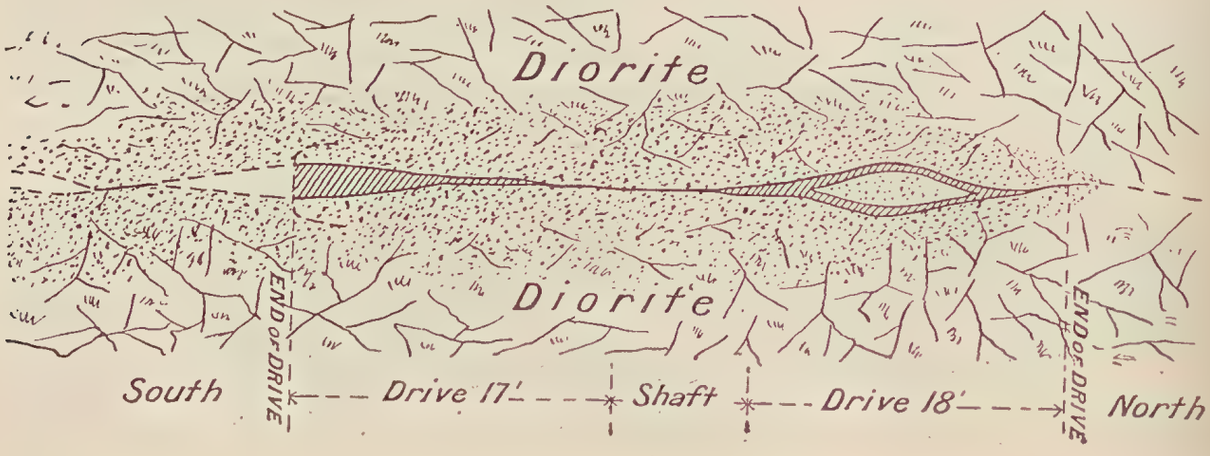
but both veins have undoubtedly pinched at the face where an average sample yielded:—

Gold	2 dwt. 14 gr. per ton
Silver	Trace
Copper	„

This impoverishment, however, may be only due to the peculiar form of the veins, as explained hereafter. A single sample taken over a width of 3 feet, where the vein is exposed on the south side of the shaft at 115 feet, gave a result as high as that obtained above from the veins in the drive.

At 140 feet the vein can be seen for a length of about 35 feet in the short drives which have been put in towards the north-east and south-west. It is not continuous for the whole of its length, as it is sometimes divided by a horse of country rock, and sometimes becomes a new thread. (See accompanying sketch of vein at 140-feet level, Fig. 3.)

Fig. 3.



There is no crosscut at this level, and only the one vein has so far been met with; average samples representing a width of about 6 inches throughout gave:—

Gold	11 dwt. 16 gr. per ton
Silver	10 „ 17 „ „
Copper	33 per cent.

There is good ore at the southern end of the drive, but at the northern end the vein has pinched to a few strings. (See Fig. 3.) The same vein has been driven along at the 225-feet level for about 35 feet.

As in the upper levels it is lenticular, the nodes being almost barren, while the loops often contain very rich copper ore, and as copper pyrites frequently occurs disseminated in the enclosing rock close to the vein, and in some cases right across the country intervening between the footwall and hanging-wall veins, the width of ore is very variable. If it were mined it might prove advisable to deal with either a small width of a rich product, or a greater width of a product of lower grade, and an average sample of the ore would yield by assay a corresponding higher result, or *vice versâ*.

The results given below are from samples which represent an average width of 14 inches for the hanging-wall vein, and a few inches less for the footwall vein, which appeared to be the full width of the valuable portion at this level.

The hanging-wall vein, which first makes its appearance at this level, is about 12 feet from the footwall vein; it has been pierced by a crosscut, but only driven along for a few feet each way.

Average samples from both yielded the following results:—

Hanging-wall vein	Gold	2 dwt. 14 gr. per ton
„ „	Silver	Trace
„ „	Copper	Trace
Footwall vein	Gold	3 dwt. 6 gr. per ton
„ „	Silver	2 dwt. 14 gr. „
„ „	Copper	0·65 per cent.

The hanging-wall vein looks very poor indeed, both at the north and south end of the drive, and at the north end of the drive on the footwall vein the ore is also diminishing considerably in size.

At the south end of the latter drive, however, where the country rock is more decomposed, the vein looks promising, and an average sample of this face gave:—

Gold	1 oz. 4 dwt. 20 gr. per ton
Silver	1 „ 0 „ 22 „ „
Copper	2·2 per cent.

The shaft has been continued to about 290 feet in depth, and at this level is wholly in hard undecomposed rock; a vein supposed to be the hanging-wall vein has been cut by a short crosscut, but it is very much reduced in size and value, samples only containing traces of gold and silver; there is also but very little trace of the footwall vein to be seen.

The shaft has evidently been sunk in a gangue of ore which appears to have a general trend towards the south as the depth increases, and the character of the footwall even at this level may be due to the shaft having passed into one of the barren nodes in the vein already referred to.

If this is the case it is possible that other loops or lenses of ore may be cut by driving along its length. There are indications of the vein making an appearance on the south side of the shaft, but as any opening out at this depth without machinery was out of the question, it was proposed to extend the south drive at the 225-feet level for about 100 feet, and then crosscut in order to intersect, if possible, some of the other veins which run through the property.

I have recently been informed that the company decided to undertake this work, which is now being carried out with encouraging results.

Mining Lease No. 26.

The shaft sunk here known as No. 2 Shaft is about 30 chains to the south-west of No. 1, and is 108 feet in depth. A vein has been driven along at the 35 feet, 70 feet, and 104 feet levels. The drive at the 35-feet level is 30 feet towards the north-east, and some ore has been stoped out for about 12 feet where the vein was about 12 inches in thickness. At 20 feet it has pinched to nothing, which may be due to a lenticular form of vein, as in the case of No. 1 Shaft. A sample from the ore-bearing portion of the drive gave:—

Gold	1 oz. 10 dwt. 17 gr. per ton
Silver	2 „ 7 „ 1 „ „

At 70 feet in depth the vein has been followed towards the south for 33 feet. There are some massive iron pyrites to be seen, and most of the mineralised portion has been stoped out as in the case of the upper level. Samples were taken at the face in this drive for a width of 2 feet, yielding:—

Gold	11 dwt. 16 gr. per ton
Silver	13 „ 2 „ „

The most work has been done at the 104-feet level, where the vein has been driven along both towards the north-east and south-west a length of about 60 feet.

The vein here divides into two branches in the northern drive, and would have an average width of 8 or 10 inches; it looks more promising at the north than at the south face.

Samples of this level gave:—

Gold	5 dwt. 5 gr. per ton
Silver	13 „ 2 „ „

The shaft has been continued for about 3 or 4 feet, but a sample from the ore exposed yielded a very poor result.

A little galena is to be seen in the ore, which might also contain a little copper, but the percentage of the latter was not determined in any sample from this shaft.

Prospecting Area No. 2.

On this area the shaft is known as the P.P.A. or Copper Shaft, and is about 30 chains south of No. 2. It is down 124 feet, and drives have been put in at 37 feet and 60 feet in depth, and crosscuts at 100 feet and 120 feet.

The 35-feet level, which has been driven about 8 feet towards the south, is above the sulphide zone, and the vein, which has not yet reached its full width, contains some oxidised ores of copper.

The principal work has been carried on at the 60-feet level, the drives having a total length of about 67 feet.

Very good ore is to be seen here, chiefly copper and iron pyrites, and some 2 tons of black oxide of copper is said to have been obtained from the south end of the drive.

The vein here is extremely irregular in both shape and value, and its width varies from nothing up to 12 and 18 inches; the average would not be more than 8 inches. Assay returns therefore, unless taken in conjunction with a carefully dimensioned plan showing the length and width of ore they represent, have no quantitative meaning and merely amount to a rough estimate of the average value of the ore. The sample when assayed gave:—

Gold	11 dwt. 16 gr. per ton.
Silver	6 oz. 5 „ „
Copper	9·0 per cent.

Near the bottom of the shaft the vein is seen on each side, and a sample representing a width of about 7 inches gave an assay:—

Gold	2 dwt. 14 gr. per ton.
Silver	11 „ 16 „ „
Copper	0·6 per cent.

There is also at this level a short crosscut towards the north and west.

About 6 feet from the vein, at the beginning of the crosscut, there is a vein of massive copper pyrites a little over 2 inches in thickness, the gold contents of which were determined thus:—

Gold	3 dwt. 6 gr. per ton.
Silver	15 „ 1 „ „

This vein is increasing in size towards the south, and it dips at a smaller angle than the vein in the shaft. It appears probable that they will join at a lower level. Another small vein, containing mispickel, calcite, &c., is to be seen at the end of the crosscut, which is 12 feet in length.

The ore obtained from the vein in No. 1 Shaft consists of copper and iron pyrites, which no doubt contains almost, if not the whole of the gold, and there is also a little mispickel in the lower levels. The rest of the vein filling forming the gangue is generally felspathic, sometimes almost pure felspar; but at the northern end of the drives, where the country is not decomposed, the vein stuff is generally calcite, with a little quartz. In some places, however, a good deal of magnetite formed part of the filling. The gangue would also always include some of the country rock on account of the disseminated mineral it contains. The ore from No. 2 Shaft shows but very little copper, and is chiefly iron pyrites with a gangue of quartz and calcite. Mispickel is present, and some galena was also seen well distributed through a specimen from the 104-feet level.

No. 3 Shaft has yielded some rich oxidised ores of copper, the zone of surface oxidisation extending to about the 60-feet level. The sulphides below this were similar to those obtained from No. 1 Shaft—viz., copper pyrites, iron pyrites, and mispickel with a gangue of quartz, calcite, and felspar.

With regard to the extraction of the valuable constituents of the ore—viz., gold, silver, and copper, I was informed that the company had purchased a stamp mill, and proposed to introduce a preliminary amalgamation treatment to obtain some of the gold and silver.

It can be seen from the assays that the average gold contents of the ore, of which there is not a very large quantity available, would not be very high, and there is no doubt that it is nearly all in a non-amalgamable form. Some would be contained in the mispickel, which is particularly harmful to the process.

The sulphurets, which form roughly between 15 and 20 per cent. of the ore of No. 1 and No. 3 Shafts, though probably a smaller percentage of the ore from No. 2 Shaft, cannot in general be made to yield 40 per cent. of their gold as amalgam, even by prolonged grinding, and the concentrates containing the copper and gold would be the most valuable product obtained.

The question of treatment is undoubtedly one of quantity of ore, and the means of access to the mine would, I think, render complete reduction at the site too costly unless very large quantities were available. In any case, the first object aimed at would be to obtain a concentrated product, and as the gold contents of their richer material would ultimately have to be extracted, there seems to be no reason for endeavouring to obtain a small percentage of the gold from an ore unadapted for battery treatment and preparing it for concentration by a costly method when, if the mine is proved to contain sufficient ore to be successful, efficient machinery for direct concentration without the intervention of amalgamated plates could be adopted.

As the veins have nowhere been driven along for more than 50 or 60 feet, and in many cases the drives have apparently passed out of the ore, I think that any proposal to commence treatment is to be regarded as premature until some of the drives have been considerably extended along the course of the vein to prove the existence of further shoots of ore, of which there seems to be a fair probability, and I should think it would be most advisable to postpone consideration of the economic questions relating to the disposal of the ore until this exploratory work has been carried out.

There are a number of other veins running through the property besides those which have been prospected. They are all approximately parallel, the average strike being nearly north-east, and in several instances shallow shafts have been sunk which have long been abandoned and have now fallen in.

A vein known as the Iron Stone Lode is to be seen about 600 feet to the east of No. 1 Shaft, and the outcrop is here very rich in oxides of iron (chiefly hæmatite), no doubt the source of the iron-stone pebbles originally found with the gold in German's Gully.

It is possible from its position that the vein is the same as that on which No. 3 Shaft has been sunk, and which was originally known as the "Black Watch Reef."

The "Wild Horse Reef" lies between those on which No. 1 and No. 2 Shafts have been sunk, and it is expected that it will intersect the latter a short distance to the south-west of No. 2 Shaft.

The difficulty of measuring accurately the respective strikes, which in any case may not remain constant, makes it impossible to predict whether such a junction will be met with.

A good deal of work was done on this reef in the early days of the field, chiefly, it is said, by one man who worked with a hand-stamper, and obtained a good deal of gold.

It was not possible to examine the old shafts, but there is no doubt that these primitive operations were checked by the sulphides, which soon made their appearance, as a quantity of ore lying at the surface which appeared to have been obtained from a depth of about 40 feet consisted largely of massive iron pyrites with a little copper pyrites similar to that obtained from some parts of the present workings.

I saw a number of other outcrops both within and without the company's property, and there is no doubt that there are a number of reefs and veins in the district which are gold-bearing, but the shafts sunk on some of them by the earlier prospectors leave very little doubt that at a shallow depth the gold is in most cases associated with large quantities of metallic sulphides, and is not in a form adapted for ordinary methods of extraction.

RECENT MINING OPERATIONS IN THE NANANGO GOLD FIELD.

The Nanango Gold Field has an area of 24 square miles. The township is situated at about the centre of its western boundary, which has a length of 6 miles, and the Brisbane Range dividing the Burnett from the Brisbane Watershed crosses the area approximately in a diagonal direction from the south-west corner. The old diggings are near the centre of the area, on the northern side of the range.

The goldfield seems to have been chiefly productive about twenty-five or thirty years ago, but the only official returns of the gold output appear combined with those of other fields of the district in the annual totals.

The gold deposits of the neighbourhood were described in a report by Mr. Rands in 1886, a portion of which is reprinted hereunder:—

"Approaching the township of Nanango by the main road from Barambah, a series of hard sandstones, quartzites, and slates is traversed. The township itself is situated just on the boundary line of this series, for immediatley south of the township a grey granite occurs which extends across the range forming the watershed of the Brisbane and Burnett waters, to and beyond Taromeo Station.

"The Nanango Diggings are situated in the scrub, about 1 mile a little north of east of the township; they are on the Burnett falls of the Brisbane Range.

"Passing along the road from Nanango to Mount Stanley, at the foot of the range a hard dark-coloured altered sandstone occurs. Three hundred yards further up the range a soft grey slate dips about 40 degrees to the west. Immediately beyond this, and overlying it, is a felspathic sandstone, coloured red and brown with oxide of iron. It shows, as a rule, no signs of stratification, although here and there, where it is of a very fine character, thin laminations were visible. In places, again, it passes into a fine white kaolin clay. It has evidently been formed from the decomposition of some highly felspathic rock; in all probability from a porphyry.

"It is in this rock that the gold has been obtained. The gold occurs in small strings or veins of quartz running through the rock in various directions, and also to a small extent in the rock itself.

"There are no true reefs or lodes whatever.

"Numerous shafts have been sunk to a small depth on this formation, but it will only be necessary to give a description of one or two of these working places.

"About a mile from the township, and just to the right-hand of the road leading to Mount Stanley Station, are old workings on small veins of quartz of from ¼ to 3 inches thick, with a slight dip to the east; they are lying one above the other, and are separated from one another by a few inches to a foot or more of rock, through which small and nearly perpendicular strings or branches of quartz run from one vein to the other. (Fig. 1.)

Fig. 1.

"The quartz is crystallised and white; sometimes coloured red with oxide of iron, or black with the magnetic oxide. The shaft has fallen in, so that only the upper part is visible; but I was informed by one of the men who sunk it that it was 132 feet in depth, and that at that depth it entered a flat formation standing on its edges. Near the surface these small veins contained good gold, but below the depth of 20 feet or so no colours of gold were obtained all the way down.

"At a second working, about half-a-mile south of the above through the scrub, a shaft 25 feet deep has been sunk also on flat lying veins, dipping a little to the east, which occur every foot or so between two walls about 6 feet apart, along which are very thin threads of quartz. The veins are similar in character to those above described, except that some of them contain more magnetic oxide of iron.

"It would appear from the bending down of the veins on the footwall as though the walls had been formed by a slip or fault. (Fig. 2.)

Fig. 2.

"Veins occur in the rock on the eastern side of the slip, but appear not to contain any gold.

"The gold is chiefly very fine, but coarse gold is visible in some specimens of quartz. A miner who has been working here for some time believes that if the whole of the material between these walls (with the exception of irregular patches of an impure kaolin clay) were taken out and crushed it would give a result of about ½ oz. of gold per ton. Should this be the case, it would pay well, for the formation is an extremely easy one to work.

"These veins are small segregation veins formed by quartz segregating in the cracks and joints of the rock.

"The summit of the range here is covered with a layer of basalt. Basalt also occurs about 4 miles to the south-west, forming the cap of a small conical hill of granite in the Nanango Paddock.

"Some true quartz reefs occur in the district in the slate series, one of which, lying about 200 yards west of the Telegraph Office in the township, can be traced for some distance in a south-south-west direction. A specimen of quartz containing gold was picked up on its outcrop. No prospecting has been done on it.

"Two miles south of Nanango, in the granite, there are two reefs of a glassy crystallised quartz, running east and west, and parallel with them is a dyke of felspar porphyry. No trace of gold has yet been found in these reefs. The granite on these ridges is covered with a granite debris, cemented together with oxide of iron.

"THE SEVEN-MILE DIGGINGS.

"The Seven-mile Diggings lie just to the south of the road to Brisbane, and are about 7 miles south-east of Nanango, on the Brisbane side of the range. The country here is a grey granite (white orthoclase and oligoclase felspars, quartz, mica, and a little hornblende); the granite is intersected in many places with dykes of felspar and quartz porphyries, and also of porphyrite, which have a bearing varying between north-north-west and west-north-west.

"Up to the present only alluvial gold has been found on these diggings. No gold-bearing reefs have yet been discovered.

"At one time nearly 700 men were at work here. Colours of gold can be got from nearly any of the gullies or creeks in the neighbourhood, but the principal working places have been:—

"*Callaghan's Gully*, which runs in a south-east direction into Yeraman Creek, about 1½ miles above its junction with Cooyar Creek; the lower part of Yeraman Creek itself; and Shepherd's Gully, which runs eastwards into Cooyar Creek, about 1 mile below the junction of Yeraman Creek. Callaghan's Gully was the best of these, and from it about 700 oz. of gold were obtained. In all the small ravines and gullies, and on the ridges on the eastern side of Callaghan's Gully, gold has been found; while in those on its western side no traces have been discovered pointing to the source of the gold as lying on the eastern side. A quartz reef, running parallel to and alongside a dyke of felspar porphyry, outcrops on one of these ridges, and on it a few prospecting holes a foot or two in depth have been put down, but without any favourable result.

"*Yeraman Creek*, too, has given fair returns; a dish I washed from a point 1 mile above its junction gave a very fair prospect; the washdirt was of granite débris and was here only a foot or two in depth from the surface.

"*Shepherd's Gully* was the next richest to Callaghan's. Gold was obtained nearly all the way up for about 1¾ miles. The gold in this gully was coarser. The largest nugget weighed ½ oz.

"In many places gold can be got by surfacing; for instance, on the ridges east of Callaghan's Gully before referred to, and on the Brisbane Road near the head of Shepherd's Gully.

"In the granite there are numerous reefs of a crystalline quartz with a glassy lustre, often iron-stained and of a gossany nature. No gold at all has been found in this quartz, but most of the reefs have a casing consisting of a fine granite debris, which varies generally from 1 to 4 inches thick, and which often contains colours of gold. This casing often penetrates into cracks in the quartz itself. Many of these reefs, especially those in the vicinity of the gullies and creeks in which alluvial has been obtained, have been prospected by sinking shafts on them.

"A shaft 15 feet deep has been sunk on a reef bearing north and south, with a slight underlie to the east, situated near the head of a gully running into Yeraman Creek; the quartz is 10 inches in width, with a casing averaging 2 to 3 inches; the walls are well defined; the quartz, especially at the bottom of the shaft, and the granite walls contain iron pyrites. Traces of gold were obtained in the casing.

"On the opposite side of this gully, 60 yards off and parallel, is another reef similar in character.

"A similar reef bearing east and west, and running parallel with a dyke of porphyrite, crosses the Shepherd's Gully near the heads. Trenches and holes on this, too, have failed to lead to the discovery of any gold.

"Again crossing Callaghan's Gully near its junction is another reef, close to a dyke of very coarse-grained granite (pegmatite), containing large crystals of tourmaline. I collected specimens of quartz from at least a dozen of these reefs, crushed and washed them, and with one exception I did not get the slightest trace of gold, and that one contained but a mere trace of gold.

"It would appear, therefore, that these quartz reefs could not have been the source of the little alluvial gold found in the gullies.

"Mineral selections have been taken up about 8 miles east-south-east of the Seven-mile Diggings.

"Several copper lodes outcrop here in the same granite formation. Their outcrop can be followed at the surface by lines of redish gossan. Their general direction is east and west. On one of these lodes which bears west 10 degrees north and underlies 20 degrees to the south, a shaft 90 feet deep has been put down on the underlie. The lode is between 2 and 3 feet thick, and to the depth reached the ore consisted of the red oxide and blue and green carbonates of copper. Very rich pieces of this ore can be picked off the heap at the surface. The quartz which forms the matrix of the lode is crystallised and honeycombed and contains fine gold.

"I should mention the fact that a few rounded and waterworn crystals of cassiterite (tin-stone) have been met with in some of the alluvial in this district; my informant being Mr. O'Sullivan, to whom I am indebted for kindly accompanying me to the various places mentioned in this report, and who has spent much time in prospecting the district. He showed me a crystal he found which was of the variety known as 'amber tin.' "

Recent mining operations have been confined to the old One-mile from the township.

The gold-bearing formation is here, as described by Mr. Rands, a felspathic sandstone, the outcrop of which trends in a northerly and southerly direction. The rock contains small segregation veins of quartz, and in these the gold is found.

The earlier miners obtained the quartz, and extracted the gold by means of a stamp-mill and other old machinery now lying on the field, but their operations were limited to shallow shafts and workings, and some time ago two syndicates were formed for the purpose of sinking to a depth hitherto unattempted.

The Nanango Dyke Syndicate have sunk a shaft to a depth of about 220 feet, and 36 chains south a shaft, which belongs to another syndicate, is being sunk, and has reached 130 feet. Between the two, and about 5 chains south of the first shaft, is an old shaft known as "Hooper's Luck," said to be 130 feet deep, which is no doubt that mentioned in Mr. Rands's report. All three shafts are, approximately, on a north and south line along the outcrop of the felspathic sandstone, and at an elevation of about 190 feet above Sandy Creek.

To the west of this line about 30 chains the soft grey slates, dipping approximately 50 degrees to the west, are exposed in an old shaft about 100 feet above Sandy Creek, and again there is an outcrop of a hardened slate in one place 3 or 4 chains to the west. A slate or shale was also met with in the east and west crosscuts of the shaft at the 191-feet level, and it appears that the formation in which the shaft is being sunk belongs to a series of interbedded slates and sandstones, &c., which is portion of a large area mapped on the Geological Map of Queensland as belonging to the Gympie Formation.

To the east of the three shafts the same slates and sandstones can be recognised by their weathering, but no regular outcrop can be found for a considerable distance. The country is covered by a dense scrub, and about 2 miles to the south-east, at an elevation of about 550 feet above the creek, the summit of the range is covered with basalt, which at one time probably extended over the whole of this area.

The shaft of the Nanango Dyke Syndicate is vertical for 60 feet, and then inclines to the west at an angle of 60 degrees from the horizontal. It is in the felspathic sandstone, which hardens considerably as a greater depth is reached, and which in its undecomposed state is a very fine-grained rock having the appearance of a hard grey felsite, showing here and there traces of iron pyrites. The quartz veins in which the gold is found vary from about ¼ up to 3 or 4 inches in thickness and run in various directions. The principal ones lie one above the other, and dip at from 20 to 25 degrees towards the east, their strike being roughly that of the felspathic rock in which they occur; others again have a strike at right angles thereto, and are almost vertical.

The lower inclined portion of the shaft passes almost at right angles through these veins, possibly themselves at right angles to the original planes of bedding of the sandstone, the upper vertical portion of the shaft cuts them obliquely.

The veins diminish in size and are poorer as the depth is increased, and at a depth of about 200 feet the vein filling is frequently composed largely of iron pyrites.

In the inclined portion of the shaft there are several changes of grade, and at about 180 feet and 191 feet there are small drives of a few feet in a southerly and northerly direction respectively. At about 180 feet what appears to be a brown shale is to be seen on the lower or eastern side of the shaft, to avoid which the grade of the shaft was slightly flattened.

Some coarse gold is to be seen in two specimens of quartz from the veins near the surface, but some "vein stuff" taken from the short drive at 191 feet only yielded on assay:—

Gold	1 dwt. per ton
Silver	2 dwt. 14 gr. per ton

While some quartz and pyrites taken from the veins near the bottom of the shaft yielded respectively:—

Gold	Less than 8 gr. per ton
Silver	3 dwt. 22 gr. per ton

And

Gold	1 dwt. 23 gr. per ton
Silver	1 oz. 6 dwt. 3 gr. per ton

Below about 200 feet a great deal of water was met with in the shaft, and as it is too small for two men to work comfortably, being below the usual size, further sinking was only carried on under great difficulties.

Constant bailing was necessary, the hoisting being done by means of a horse-whim, and the cost of continuing became prohibitive when a depth of about 220 feet was reached. There appeared to be little advantage to be gained by sinking beyond this, and a proposal to open out above water-level was adopted.

Crosscuts were put in at 191 feet, and at a short distance in these crosscuts both to the east and west brown shale was met with dipping to the west at about 60 degrees.

I have been informed that coarse specks of gold were found in the quartz veins when in contact with the shales, and also to some extent in the shales themselves at the junction.

The crosscuts were put in subsequently to my visit, so that I had not an opportunity of inspecting the different formations; but I understand that the gold-bearing quartz veins discontinued when the shale was met with, and, if this is the case, I do not think the latter formation worth any extensive prospecting.

There seems to be certain limits of width between which gold occurs, but, as mentioned in Mr. Rands' report, there is no gold-bearing formation having defined walls. The shaft has apparently followed an inclined bed of sedimentary origin, and the veins are small segregation veins formed by quartz seggregating in the cracks and joints of the rock. From their quality at the lower limit of the shaft there does not appear to be much to be gained by continuing the shaft in its present direction.

About 5 chains south of the shaft of the Nanango Dyke Syndicate is the old shaft known as "Hooper's Luck." Only very meagre information could be obtained with regard to its history or productiveness, but apparently at some point slates were met with, as there is a small heap lying at the surface, and the shaft seems to have been abandoned on reaching 130 feet.

This shaft, which is now being worked belonging to the other syndicate, is about 36 chains further south again, at a higher elevation of 40 or 50 feet.

The shaft is called the Golden Pile, and is vertical, having reached a depth of 130 feet. The rock passed through is the same as that met with in the Nanango shaft.

There are numerous old shallow shafts and workings surrounding these three shafts, and the miners always confined their prospecting operations to the outcrops of the yellow felspathic sandstone, and did not, as a rule, work below 20 or 30 feet.

A good deal of gold must have been obtained from the workings both here and at the Seven-mile Diggings, but I did not visit the latter, which are described in Mr. Rands' report, and where, I believe, no important developments have since taken place.

PROSPECTING TUNNEL AT JIMNA.

The Jimna (now Yabba) Gold Field is situated about 40 miles south-west of Gympie. It can be reached from that place, but the best route is that from Caboolture, *viâ* Woodford and Hopetoun.

While visiting the district to report on the prospects in connection with the tunnel which is being driven in order to work some alluvial drifts of Jimna or Yabba Creek, I took the opportunity of inspecting the mining operations in progress at the old Jimna Diggings.

Near the source of Yabba Creek, where it runs through these old diggings, the country for a considerable distance on either side, and also in the bed of the creek, was at one time extensively worked for gold. The tunnel is situated on Yabba Creek, 4 miles lower down, and the attached sketch plan shows its position and a portion of the creek in the immediate neighbourhood.

Above the tunnel Yabba Creek has an irregular and winding course, and its bed is sometimes on granite and sometimes on sandstone or slate. Its mean direction appears to be approximately that of the junction line of an area of granite on the north, and a series of slates, quartzite, and schistose rocks on the south.

The bed of the creek has in many places been filled with large alluvial deposits of different ages, which form gravel beds and flats of considerable area.

Some of the older deposits are believed to be gold-bearing, but the water-level is only a few feet below the surface, and miners have hitherto been unable to "bottom."

Just in front of the tunnel there is a large gravel bed of this kind, and the creek then bends sharply on its downward course from a southerly to a northerly direction, forming a long, narrow point about 15 chains long and 4 chains wide.

In order to overcome the difficulty of reaching the gravels through the wet ground, a prospecting party under the name of "O'Dwyer and party" have driven a tunnel through this point of land and provided a low-level conduit, which it is hoped will enable the water to be disposed of, and the gravels to be approached and worked if gold bearing.

The success of the undertaking depends both on its value as a scheme of drainage, and on the richness and existence of the gold-bearing drift. With regard to the former I had no means of taking accurate levels, but the attached sketch section (see Plate IV.) has been prepared from information supplied by the men in charge, which appeared to be fairly correct.

The distance along the bed of the creek between the two ends of the tunnel is about 25 chains, which means considerable difference of level, and the tunnel has been driven with a good fall.

The flow at the present end of the tunnel is 2 feet below the surface of the granite; and it therefore seems very probable that the tunnel, if continued, would be below the level of the deepest alluvial drift (wrongly termed "deep lead" by the miners), and that by its means the gravel deposits could be explored. For the first 70 feet the tunnel is in a soft micaceous sandstone, and it then passes into a decomposing granite.

This granite is in a soft and rotten state on the surface, and when the prospect was undertaken it was supposed that the same soft rock would be met with in the tunnel. Unexpected difficulties, therefore, presented themselves when large spherical boulders of granite were met with and had to be driven through. This necessitated heavy mining and timbering, and the falling of one of these boulders was the cause of an injury to one of the miners, which involved the syndicate in a lawsuit, and absorbed all the funds.

Work, therefore, had to be discontinued when the tunnel reached 260 feet, and for this distance, which just brought it through the hard rock, aid from the prospecting vote was obtained. With regard to the value of the alluvial gravels, there are at different levels along the banks of the creek several deposits of different ages.

Below the tunnel the points and bends have been worked at a higher level, and about 8 chains below the mouth of the tunnel gold is now being obtained. The bed rock of schists and slates can be seen in one or two places.

Above the tunnel only very little prospecting has been carried on. A few shallow holes were put down just in front of the work, but only a very small depth was reached on account of the large quantity of water met with, and at a point about half a mile further up the creek there is a shallow shaft sunk in an old drift from which a better gold is said to have been obtained.

Just a little above this shaft, the creek cuts through an older gravel bed which is exposed in the bank. It has a thickness of about 12 feet, and is resting on a micaceous sandstone. This gravel is said to have yielded good colours.

Only these meagre particulars with regard to prospecting could be obtained, and I could get no authentic information of anything beyond the so-called colour having been found either immediately in front of, or for a considerable distance above, the site of the tunnel.

The direction of the creek has evidently been frequently changed, and the configurations of its course much altered by scour and by large quantities of detritus brought down in time of heavy rain, and some of the older gravel deposits have been cut through and may in some places have even been completely washed away by floods.

Above the tunnel, for half-a-mile or more, all the older drifts have been covered by a large deposit of recent date—probably 1893—so that it is not possible to locate any particular deposit in the immediate vicinity of the tunnel, and there is therefore not much evidence of the existence of a gold-bearing gravel bed in the flat proposed to be worked.

I think such a deposit would be more likely to be found on the eastern than on the western bank of the creek, but it may have been entirely removed at this point by a former flood.

The present limit of the work, as will be seen on reference to the attached section, is on the western bank of the creek, and I understand that aid from the prospecting vote is being sought to continue driving for 150 feet. (See section, Plate IV.)

The end of the tunnel is now in a very impervious blue mud or silt, and though alluvial gravel will probably be met with at an early stage, I think that in any extensive proposal, 150 feet at least would have to be provided for in order to completely exhaust the possibilities of the scheme. The hard rock having been passed through, the cost of extending 150 feet, which should not exceed from 20s. to 30s. per foot, would be very small, compared to the original outlay, and even if the prospects of meeting with a rich alluvial drift are not very promising, it would be preferable to continue the tunnel than to abandon the whole undertaking at such a stage.

The old Jimna Diggings are situated some distance further up the creek at a considerably higher elevation, the distance by road from the tunnel being about 4 miles in a southerly and westerly direction.

Operations are now chiefly confined to work on what is called the Empress Reef, which is situated just above the creek on the southern side.

The date at which Jimna Gold Field was first worked is somewhat obscure, and very little reliable information can be obtained from the residents, but it appears to have been worked on and off for more than thirty years. The field was never highly productive, except at first for alluvial gold, the alluvial drift having been worked for some miles along the course of both Sandy Creek and Jimna Creek.

The Empress Reef, which is an area of granite on the southern side of Jimna Creek, is probably identical with that originally known as Montimore's Reef, which is said to have been "the first auriferous reef observed in the colonies traversing granite country."* On the northern side of the creek outcrops of sandstone, quartzite, and in some places diorite, are to be seen; the diorite is probably of intrusive character, and the sandstone, quartzites, &c., no doubt belong to the series previously mentioned as outcropping close to the prospecting tunnel.

The Empress Reef is being worked by the Mount Jimna Gold Mining Company. The deposit consists of an auriferous quartz reef, having a thickness of from 6 to 18 inches, and, as already mentioned, the enclosing rock is granite.

The reef lies very flat, the angle of inclination being not more than about 20 degrees. The strike is 25 or 30 degrees east of north, and the dip is towards the west.

This property had been previously worked by another company, and the Mount Jimna Company acquired possession some few years ago

The outcrop is on the slope of the creek, approximately at right angles thereto, and the workings consist of a tunnel driven along the course of the reef, which was then sloped towards the outcrop.

The mine is well timbered and easily worked, after the manner of a coal seam. The first 70 feet and last 5 feet have not been sloped, but the remaining 105 feet has all been removed nearly to the surface, about 120 feet.

Some of the best gold has been obtained from small veins or leaders which are found on the hanging-wall and footwall of the main vein, and are almost vertical.

Work has chiefly been confined to the upper or outcrop side of the tunnel, but in one place, at about 100 feet in the tunnel, the reef has been followed down a short distance on the lower side, and some good ore was obtained. Metallic sulphides are evidently making their appearance as the vein goes down, some massive iron pyrites being seen, and I also saw some galena in one specimen. The presence of gold in the pyrites does not seem to have been determined.

The same company are also sinking a shaft about 250 yards to the west to cut the reef at a greater depth; this is now down 130 feet.

The mine is being worked with five men, and the ore, which consists of ordinary white quartz, is mined and carted to a small crushing mill of two steam stamps. There is also on the field a light battery of six stamps of the ordinary type, and two Berdan Pans. The latter crushing plant has been purchased by a Gympie Syndicate.

The mine output for one year was between 300 and 400 tons. No very rich ore has been obtained, and crushings seem to have varied from 6 or 7 dwt. up to a little over 2 oz. per ton. The mill records available were hardly reliable enough for publication.

A little to the north of the Empress Reef there is another reef known as the Victory; its strike is roughly in the same direction as that of the Empress, but its dip is somewhat greater. As far as I could learn the vein was about 12 inches in thickness, and the character of the ore similar to that of the Empress; only a little work was done on the reef.

There are also other reefs in the locality, and with facilities for crushing and treatment one would not expect any, which were sufficiently rich to be profitable, to long remain idle.

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* "Mineral Wealth of Queensland."—R.L.J. Brisbane By Authority, 1888}

THE COBALT DEPOSIT OF THE BLACK SNAKE DISTRICT.

The Black Snake district, which at one time was expected to develop into an important centre of mining operations, has been almost entirely deserted for a number of years.

It is situated 8 or 10 miles south of Kilkivan, the nearest railway terminus, from which, with the exception of one or two short steep grades, it is easily accessible.

The cobalt deposit is on the eastern slope of a steep, narrow spur, the highest points of which are Mount Cobalt, immediately behind the deposit, and Mount Coora, which is the highest point in the neighbourhood, about 20 chains to the south.

This spur runs in a northerly direction from Mount Coora, and separates the head of Fat Hen Creek from a steep gully which joins it at the northern end of the spur.

The workings are in extremely steep and precipitous country which rises abruptly to nearly 1,000 feet above Fat Hen Creek, and on this account communication with, and the transporting of mining material to the various workings on the property, is very laborious. The slopes are rocky and poorly timbered, draining into Fat Hen Creek, and finally into Wide Bay Creek and the Mary River.

The first official record of the occurence of cobalt in this neighbourhood is to be found in a report on the district by Mr. Rands in 1886,* and subsequently in a short report on the deposit in 1887,† in which the discovery of the mineral is attributed to Mr. F. Smith. The property was formerly owned by Mr. Walter Smith, of Maryborough, and then by a Banking Company, finally coming into the possession of the present owners in 1898. This, so far as is known, is the only cobalt deposit in this State, and up to the present only small quantities of cobalt minerals have been found in one or two localities. Erythrine (hydrous arseniate of cobalt) occurs at Mount Biggenden in the Gayndah district, and asbolite (cobaltiferous wad) in the Cloncurry district. The ore at Mount cobalt consists of asbolite.

The holders of Mount Cobalt have an area of 74 acres to include the cobalt deposit, and they have also another prospecting area; in this the old Black Snake Mine is situated, which they propose to re-open and further prospect. The gold-bearing reefs of the Black Snake district are situated near the western edge of a circular boss of porphyry, which has a diameter of about 1½ miles. The cobalt deposit occurs in a mass of serpentine rock about a mile to the north, and between the two there are outcrops of a highly altered volcanic rock, and of quartzite and schists, &c.

The volcanic rock is of an ultra-basic character, and probably olivine was originally a prominent constituent; but its ferro-magnesian minerals are now so much decomposed and altered into serpentinous products that, without the examination of a number of microscopic sections, it is impossible to determine their original form.

The serpentine rock has a prevailing dirty green colour and streaky appearance, and veinings of different minerals ramify through it in all directions. The rock in many places appears much crushed, and contains a good deal of secondary silica, also veinlets consisting largely of the silicates of magnesia and nickel, and nodules of a cherty substance containing a little nickel.

Most serpentine rocks are derived from olivine rocks, or rocks consisting largely of magnesia silicates by alteration, and there are here certain points in common between the serpentine and the altered volcanic rock adjoining. They may be varieties due to different phases of alteration, but more elaborate investigations must be made in order to pronounce a definite opinion as to the probable origin of the serpentine.

The cobalt, so far as the deposit has yet been explored, is found wholly in this rock, which in many places appears to be considerably decomposed, and the outcrop stained a brown colour on the surface by oxides of iron.

Cavities in the rock filled with quartz are prominent features in the weathering, and it also exhibits a number of black and pink stains, the latter being probably due to a manganese mineral, diallogite or rhodonite, and the former to the oxides of cobalt or manganese.

The decomposition of the serpentine evidently extends to a depth beyond the limit of the present workings about 100 feet, and may be due primarily to a small fissure, or may possibly represent the zone of maximum metamorphism.

It is in one of these areas of decomposed serpentine that the cobalt occurs, and it can be traced by its outcrop for some distance on each side.

The work done has shown the formation to have a width of about 33 feet, and it is also apparently dipping towards the west at an angle of about 40 degrees.

It has on this account, and from its general similarity to the ordinary lode formation, been called "The Cobalt Lode." Asbolite, or earthy cobalt ore, is found in greater quantities on what may be termed the footwall of the formation, which, however, does not appear to continue in a north and south line, but on either side of the deposit trends to the west forming a convex bend.

The ore occurs in bunches and botryoidal masses, and also to some extent in veins and pockets which possess no defined form, and which are scattered in an irregular manner through the decomposed area of serpentine. Its colour is black or bluish-black, the latter being richest in cobalt.

On the footwall of the formation there is a casing about 10 feet in thickness of a steatitic clay having a greenish appearance due to the presence of infiltrated silicate of nickel, and on the hanging-wall, as described in Mr. Rands' report, material consisting largely of silicates of magnesia, aluminia, and a little silicate of nickel, a substance resembling pimelite. Bunches or pockets of almost pure steatite occur between the two walls where the rock has decomposed into a siliceous clayey substance.

Where the steatitic casing has been stripped in an open cut the formation has a contorted or foliated appearance, and nodules of ore varying from 1 or 2 up to 6 or 7 inches in diameter are found interleaved in the bends or foliations; they also occur in the steatitic casing, and their appearance generally is suggestive of concretionary origin. The ore in the main bulk of the formation

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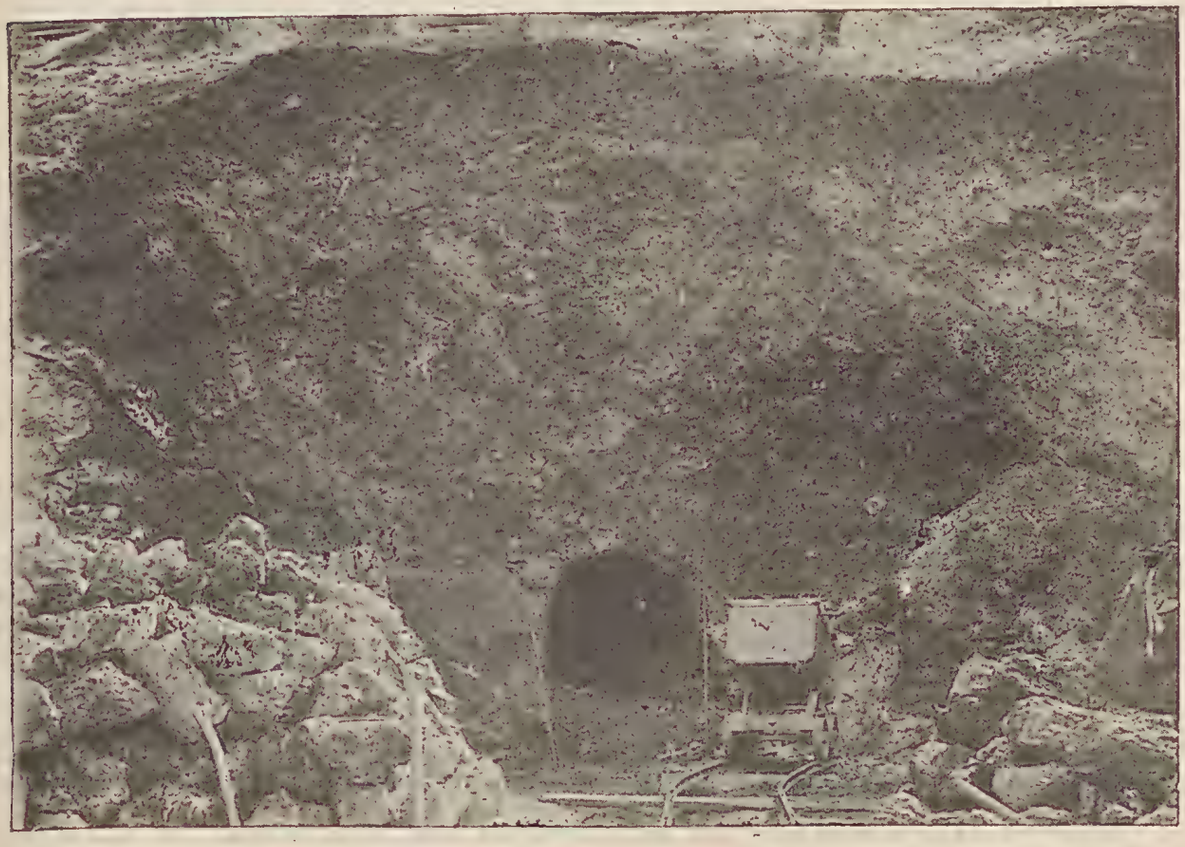
* Geology and Mineral Resources of the Districts of Kilkivan and Black Snake. By Authority: 1886.

† Report on a Cobalt Lode at the Black Snake, near Kilkivan. By Authority: 1887.

is often accompanied by a deposit of infiltrated quartz. The original work consisted of an inclined shaft sunk along the hanging-wall to a depth of 80 feet or more, from which crosscuts were put in towards the east and west. These workings subsequently became filled up and were in great part lost.

Fig. 4.



Open Cut on Cobalt Deposit.

Later work consisted of an adit driven in an approximately north-west direction and piercing the formation about 40 feet below the surface. Short drives towards the north and south were put in along the footwall where the rich ore was obtained and turned to the north-west and south-west for a short distance to explore the formation, the tunnel was then extended to the hanging-wall and turned to the north-east to follow it for some 50 or 60 feet where crosscuts were put in.

At about 30 feet in this last drive a winze was sunk for 70 feet and crosscuts put in, also a drive along the formation in a northerly direction for 130 feet. An open cut has also been made which has exposed part of the footwall.

The direction in which the cobalt-bearing formation extends has been estimated by different observers at from north to north-east, a discrepancy probably due to its curved form in the immediate vicinity of the deposit.

As already mentioned, the rock is more decomposed in some places than in others, and areas of the brown decomposed outcrop, showing superficial markings of manganese and cobalt, are to be seen in a number of different places; but it is difficult to form a decided opinion as to whether they belong to one continuous outcrop, as between the limits where the formation is found is about 35 chains, and it cannot be satisfactorily traced without considerable breaks and gaps for the whole distance.

There are, however, several outcrops in the serpentine which lie approximately in a north and south line, and, working on the assumption that the formation is continuous in this direction after the manner of an ordinary metalliferous lode, a tunnel was driven to intersect it at a point about 7 chains to the south. This is known as No. 1 Tunnel. (See Plate V.) It crossed the north and south line after going a short distance, but beyond a somewhat similar formation, containing a little of oxide of manganese and small veins filled with quartz and the silicates of magnesia and nickel, nothing of importance was met with for 350 feet. About 9 or 10 chains south of this No. 3 Tunnel is being driven for the same purpose and has reached about 40 feet. Five chains further south again there is a trench in which some oxides of manganese and cobalt are to be seen. It may here be remarked that both ordinary wad, which often contains traces of cobalt, and cobaltiferous wad, being essentially manganese minerals and having very much the same appearance, it is difficult to say whether these small outcrops and superficial markings are due to the cobaltiferous variety or otherwise.

There are, however, appliances on the mine for making most complete analyses and tests, and no misunderstanding should exist in this respect.

The No. 2 Tunnel is being driven to prospect the quartzose formation which outcrops at the summit of Mount Coora. (See Plate V.) It passed through a hard quartzite, after which purple jasperoid slates were met with striking nearly north and south, and almost vertical. The tunnel is a little over 300 feet in length, and as far as is to be seen there is not much encouragement to continue it. This constitutes the extent of the prospecting in the immediate neighbourhood of the cobalt deposit.

With regard to the extent and size of the deposit, there is some difficulty, as already mentioned, in coming to a definite conclusion as to whether the different outcrops are parts of the same formation or whether they are separate. I am inclined to the latter opinion, and though it is quite probable that other ore bodies lie beneath them, their existence has not so far been proved.

Knowledge on this subject is therefore confined to the upper workings where, up to the present, all the cobalt ore has been obtained, and here at the eastern or footwall side of the formation some good ore is to be seen in an open cut at the surface which is 30 feet wide, and also in a crosscut at a depth of about 70 feet.

I am of opinion that this constitutes the valuable portion of the deposit, as, as far as can be seen, the ore in the main body of the formation does not occur in sufficient quantity to make it worth removing, and unless the ore on the footwall or outer margins of the formation is found to extend for a considerable distance, there will be great difficulty in obtaining a sufficient supply for a profitable and regular output.

It would appear, therefore, advisable for the bulk of the labour to be expended in exploring the footwall or outer edge of the formation rather than on tunnels in more remote places, though thorough prospecting of the serpentine is very desirable.

The cobalt deposits of New Caledonia, which have produced such a large share of the world's production, are in serpentine, as is also the other chief deposit of Australia, that of Port Macquarie in New South Wales. At these two places it is only in the serpentine and the clays which have resulted from its degradation that the cobalt is found, and in many respects the deposits bear a close resemblance to that of Mount Cobalt.

New Caledonia has also produced in the last decade the greatest proportion of the world's supply of nickel, and the occurrence of nickel at Mount Cobalt is an additional inducement for thoroughly prospecting the serpentine country.

The upper or decomposed portion is where, I think, the cobalt ore is most likely to be found rather than at a greater depth in the unaltered rock, as the facts appear to suggest. The process of segregation of the cobaltiferous wad has been assisted by the decomposition of the serpentine.

The two metals—nickel and cobalt—nearly always occur together; but although the number of compounds with arsenic and sulphur involving nickel and cobalt is large, as a source of cobalt nickeliferous pyrrhotite and pyrite are the most important; but by far the most important ore of cobalt is cobaltiferous wad. Metallic cobalt is only occasionally found in meteoric iron associated with nickel.

Metallic cobalt is not used in the Arts, and the consumption of cobalt is confined to its use chiefly as oxide and for the manufacture of pigments—a blue green and yellow being manufactured from cobalt compounds. Its chief use, however, is for tinting glass and porcelain, and also for the manufacture of the blue enamel on ironware.

The world's production of cobalt (metallic) was in 1892 stated to be 200 tons per annum, but though no new channels have opened for the consumption of cobalt, the demand for the oxide has been increased by the expansion of the few manufacturing industries to which its use is confined. Thus the output of New Caledonia increased from 2,200 tons of cobalt ore in 1892 to 3,390 in 1899, and of the United States from 3·5 tons of oxide to 27 tons.

Cobalt ore is also exported from Chili, and in 1899 New South Wales produced 193 tons of ore. The value of commercial cobalt oxide advanced from 6s. 6d. in 1899 to a little over 7s. per pound in 1900,* the price of pure oxide being greater. The price paid for the oxide in the ore would probably be less than half this amount, as the process of extraction is very costly, and the market is apparently controlled by a ring of English and Continental purchasers.

The output from Mount Cobalt has, so far, been confined to about 10 tons of samples, and these are said to have been badly selected and to have contained a good deal of the non-cobaltiferous wad.

There are now several tons of ore bagged ready for export, and I understand that the Mount Cobalt Company have made special arrangements for the disposal of this in England, there being a ready market for all the ore that can be obtained in this State.

The mining of the ore does not present any special difficulties except that of careful management of the timbering on account of the steatitic or greasy nature of the formation about the footwall where the rich ore occurs. The nodules of ore can generally be obtained with the pick alone, but have to be delivered of their associated clay and gangue and roughly graded before being bagged.

The ore being friable and powdery is unsuitable for mechanical concentration, and will therefore have to be hand-picked—a process which, if carried out successfully, will require systematic management and a regular supply of ore. The cost of carrying ore to the nearest railway terminus would be about 35s. per ton.

The quality of the ore depends chiefly on the percentage of cobalt, as the impurities—manganese, &c.—are removed in metallurgical treatment by precipitation.

Some assays of the ore quoted in Mr. Rands' report of 1887 are as follow:—

—	Assay by—	Cobalt.	Nickel.	Manganese.	Copper.	Iron.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1. Surface ore	W. Vivian and Sons ...	2·75	2·25	65·00	...	...
2. Undressed ore	Staiger	7·50	2·12	...	...	...
3. Undressed ore	„	4·30	1·00	...	...	...

And the result of an analysis of some of the ore taken from the bags lying ready for shipment gave:—

	Sample 1.		*Sample* 2.	
Silica and insoluble	42·90 per cent.	...	...	
Iron and alumina (Fe_2O_3 Al_2O_3) ...	14·25 „	...	...	
Manganese (Mn)	18·45 „	...	...	
Cobalt (Co)	2·74 „	...	Cobalt (Co)...	2·436 per cent.
Nickel (Ni)	3·57 „	...	...	

* Mineral Industry, 1901.

This may be compared with the ore which is mined in New Caledonia, which is approximately of the following composition* :—

Peroxide of manganese	18·0	per cent.
Peroxide of cobalt	3·0	„
Protoxide of nickel	1·25	„
Silica	8·0	„
Ferric oxide	30·0	„
Alumina	5·0	„
Lime	1·0	„
Magnesia	1·0	„
Moisture	32·75	„

So far, cobalt has not been found in the other large areas of serpentine in this neighbourhood, but a deposit of wad, which may be found to contain a little cobalt, occurs in some old workings at Skibbereen Creek, about 8 miles north of Mount Cobalt.

Besides the cobalt, there was at one time a good deal of mining for gold and copper in the district, notably the Black Snake Reef, and the Rose, Shamrock, and Thistle Reef. The former was very rich, and is supposed to have been cut off by a cross-course. It is the intention of the Mount Cobalt Company to re-open some of the old workings in the hope of finding the faulted portion of the reef.

The Rose, Shamrock, and Thistle Mine is being kept free from water and the machinery kept in repair, but is not being worked, the present owners endeavouring to sell the property. The mine is 300 feet deep, with a considerable amount of exploratory work done underground.

Most of the auriferous reefs in the Black Snake district contained a very large proportion of metallic sulphides, and attempts were made to extract the gold by saving the pyrites and smelting, for which purpose furnaces were constructed at great expense on the spot. The attempt seems to have failed, the furnaces being out of operation some years previous to 1875, and now in ruins.

Copper-mining was confined to Mount Clara and Mount Coora Mines, at both of which the lode is in serpentine. These mines are now abandoned. Three furnaces once worked at Mount Coora, but the product was not refined, being exported in the crude state for subsequent extraction of the gold and silver.

A furnace was also erected at Mount Clara, but did not work for long, the ore being afterwards sent to the Mount Coora furnace for treatment, where its large percentage of iron rendered it useful to assist in smelting the ores of Mount Coora.

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* Mineral Industry, 1892.

[No. 169 of the Geological Survey Publications.]

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By Authority: George Arthur Vaughan, Acting Government Printer, William street, Brisbane.

GEOLOGICAL SKETCH

With Plan & Section of Workings

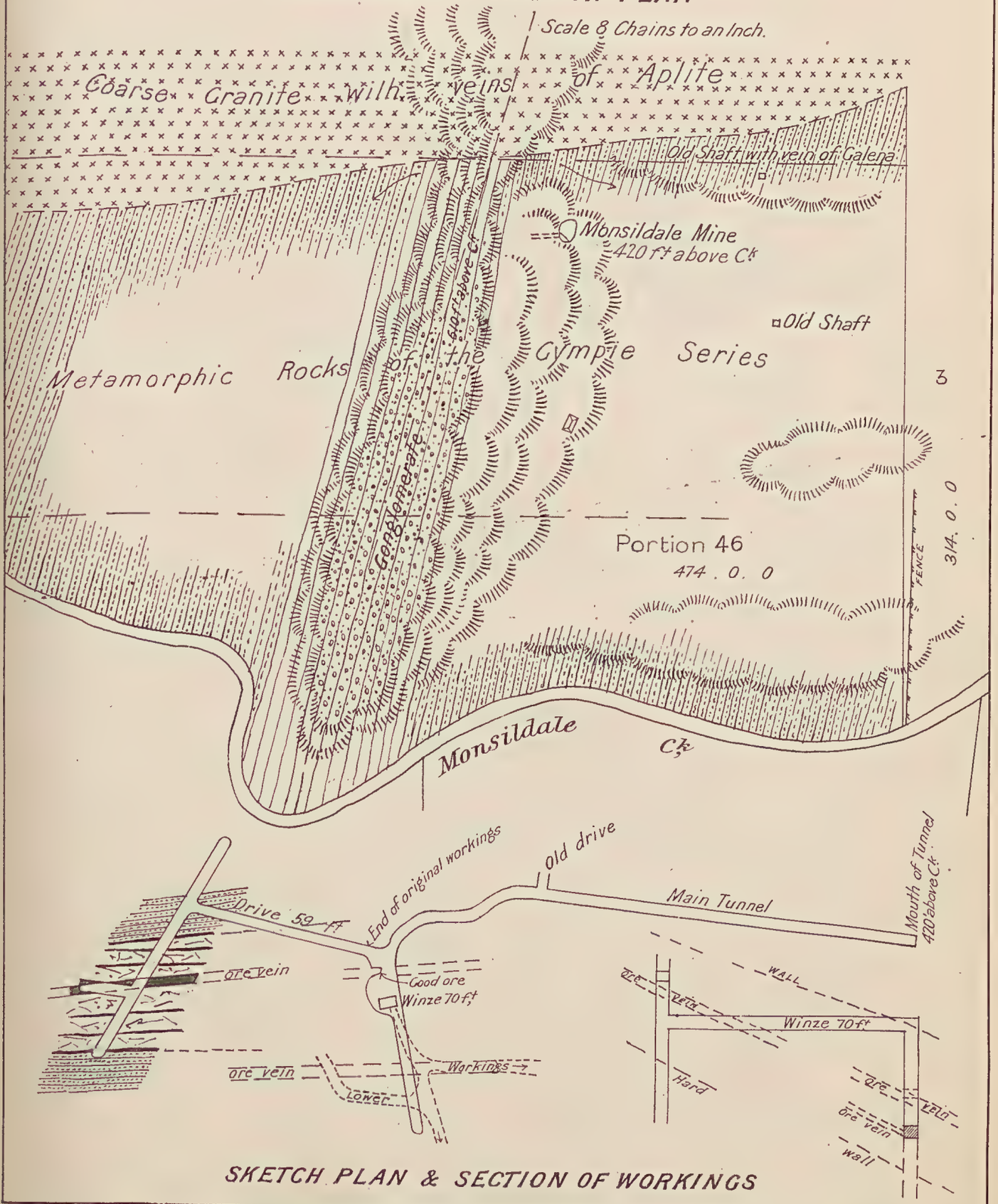
Silver Lead Deposit at Monsildale

To accompany Report on Some Mines and Mineral Deposits at the heads of the Brisbane, Burnett and Mary Rivers

By C.F.V. Jackson, Assistant Govt Geologist

1901

GEOLOGICAL SKETCH PLAN



SKETCH PLAN & SECTION OF WORKINGS

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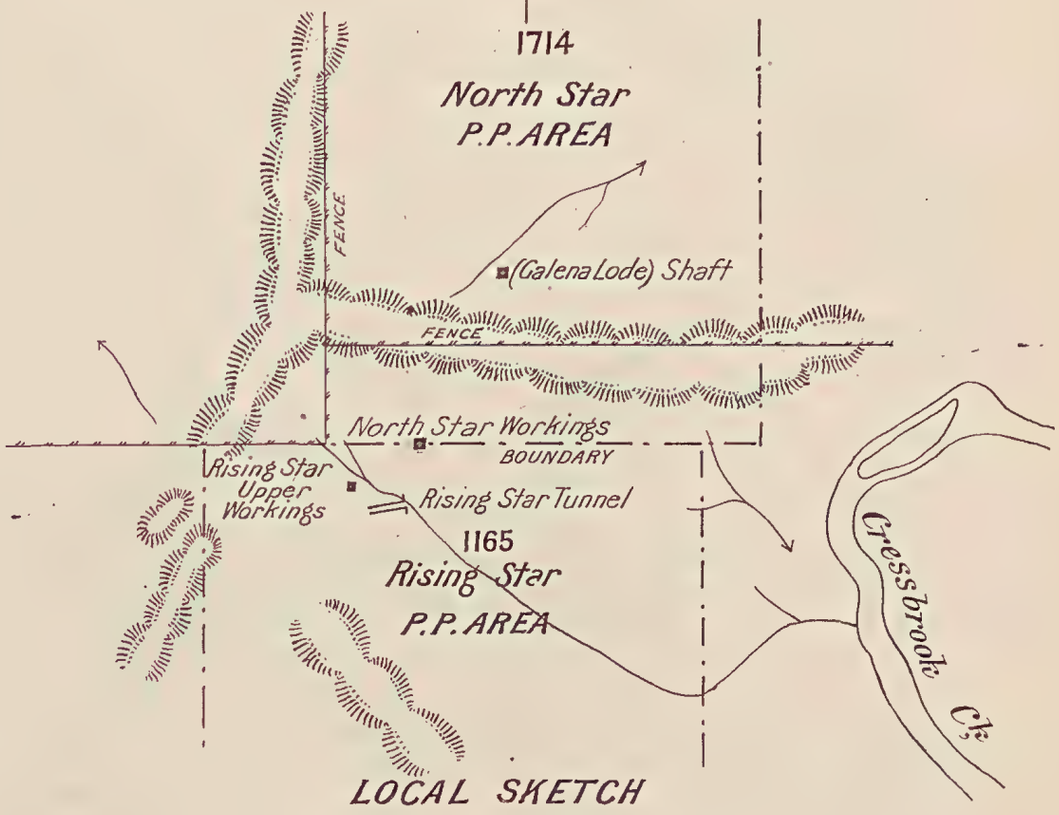
NATIONAL

LOCAL SKETCH
AND PLAN OF WORKINGS
Rising Star & North Star Copper Mines
PARISH OF BIARRA

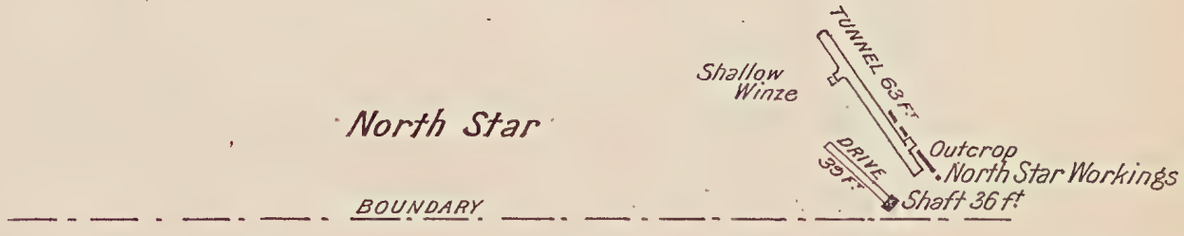
To accompany Report on Some Mines and Mineral Deposits at the heads of the Brisbane, Burnett and Mary Rivers

By C.F.V. Jackson, Assistant Govt Geologist

1901



LOCAL SKETCH



PLAN OF WORKINGS

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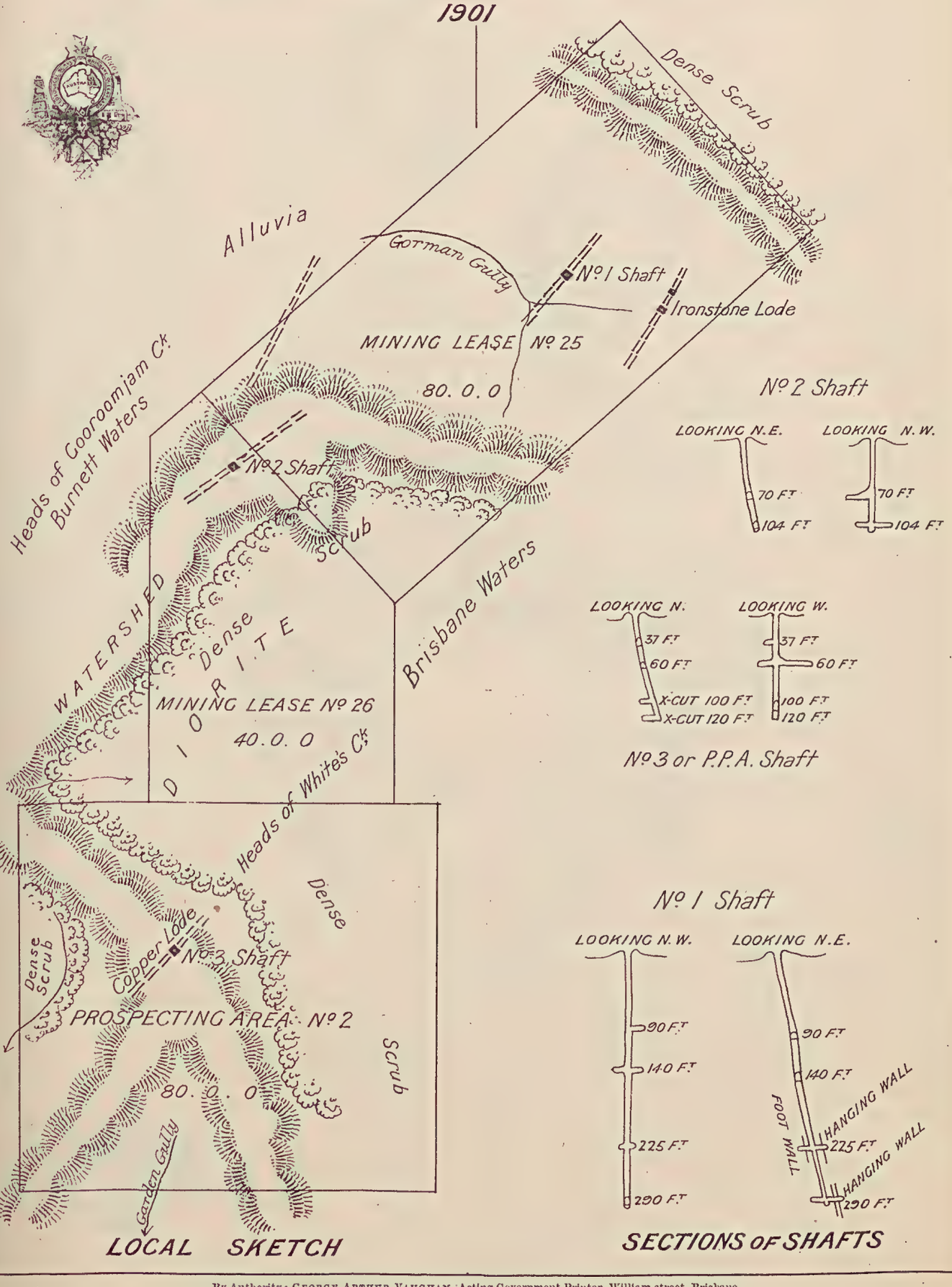
LOCAL SKETCH
AND SECTION OF WORKINGS, GYMPIE COPPER MINES
Gooroomjam Creek
To accompany Report on Some Mines & Mineral Deposits at the heads of the Brisbane, Burnett & Mary Rivers

By C.F.V. Jackson, Assistant Govt Geologist

1901



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MUSEUM
VICTORIA

LOCAL SKETCH SHEWING POSITION OF PROSPECTING TUNNEL AT JIMNA
AND AREA PROPOSED TO BE WORKED

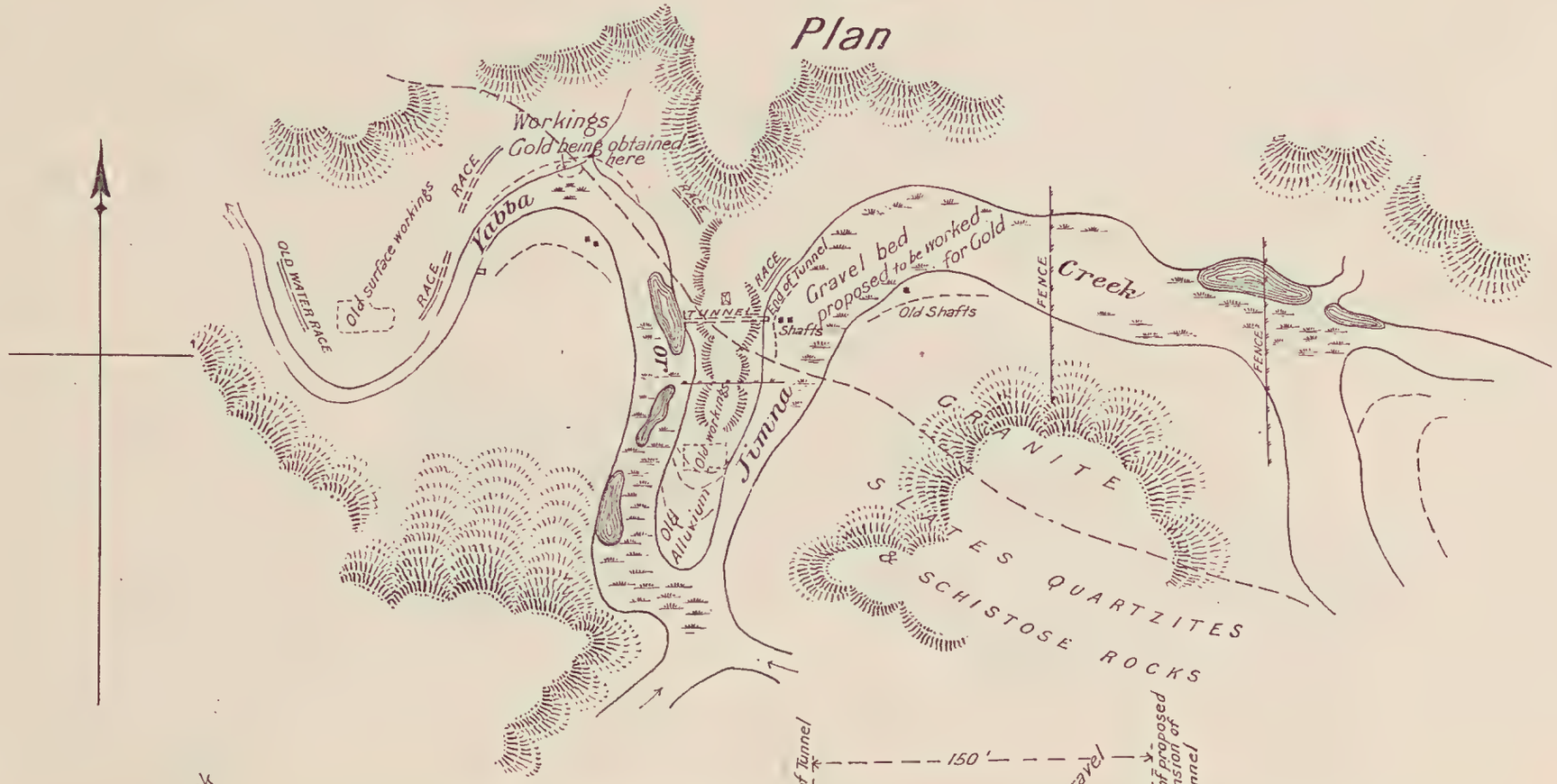
To accompany Report on

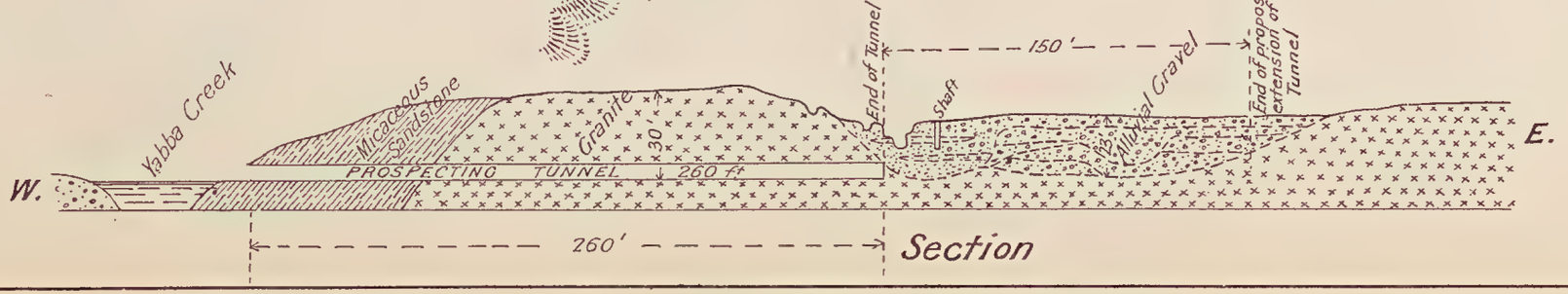
Some Mines & Mineral Deposits at the heads of the Brisbane, Burnett & Mary Rivers

By C.F.V. Jackson, Assistant Govt Geologist

1901.

Plan





Section

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KANSAS MUSEUM

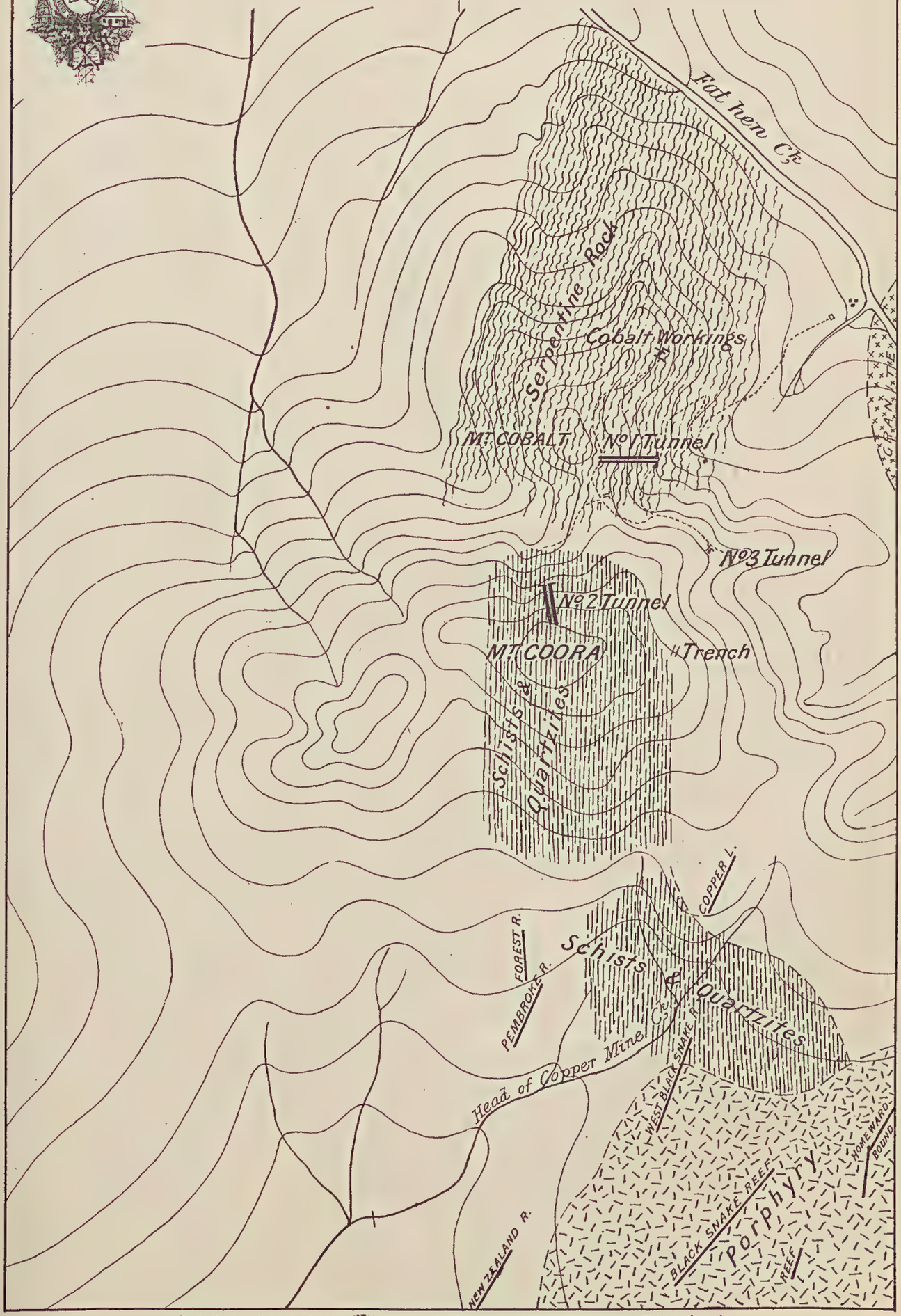
LOCAL SKETCH PLAN

of Cobalt Deposit of the Black Snake District

To accompany Report on Some Mines and Mineral Deposits at the heads of the Brisbane, Burnett and Mary Rivers

By C.F.V. Jackson, Assistant Govt Geologist

1901



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MATTONIA VICTORIA

VICTORIA.

1902.

QUEENSLAND.

THE BURRUM COAL FIELD.

(REPRINT OF REPORT ON, WITH CORRECTIONS AND ADDITIONS, BY WILLIAM H. RANDS, A.R.S.M., F.G.S., GOVERNMENT GEOLOGIST)

[*With 2 Maps and 3 Plates*]

1886;

AND

(REPORT ON, BY LIONEL C. BALL, B.E., ASSISTANT GOVERNMENT GEOLOGIST)

[*With 3 Plates*]

1901.

Presented to both Houses of Parliament by Command.

THE HONOURABLE THE MINISTER FOR MINES, BRISBANE.

Geological Survey Office,
Brisbane, 4th December, 1901.

SIR,—I have the honour to forward herewith "Reprint of my Report on the Burrum Coal Field, with corrections and additions, with two Maps and three Plates, 1886, and Report on the Burrum Coal Field by Mr. Lionel C. Ball, Assistant Government Geologist, with three Plates, 1901."

I have, &c.,
WILLIAM H. RANDS,
Government Geologist.

REPORT BY WILLIAM H. RANDS.

The town of Howard, near the centre of the Burrum Coal Field, is situated about 18 miles north-east of Maryborough, and a mile west of the Burrum River, which flows north into the Pacific Ocean.

It is in this neighbourhood that the chief work of developing the field has been carried on. Considering, however, the number of years that the existence of coal-seams of workable thickness has been known, comparatively little has been done in that direction; nor does the completion and opening, two years ago, of the line of railway between Maryborough and Howard appear to have given such an impetus to mining enterprise in the district as might have been expected. This lack of enterprise is certainly not due to a want of a market for the products, for the demand for coal in the district is greater than the collieries now at work can meet; and coal is still being shipped to Maryborough from New South Wales. A continuation of the Howard line of railway to Bundaberg is now in course of construction. This line, over 40 miles in length, will pass for most of its distance over totally unexplored coal measures, and besides opening up another market for the coal from the immediate neighbourhood of Howard, will undoubtedly act as a great incentive to the development of that portion of the field lying to the north of that place.

In the early days the coal was worked by means of drives, put in on the outcrops of the seams where they were exposed in the steep bank of the Burrum River. These drives were considerably below flood-mark, and hence the workings were always liable to be flooded; and, moreover, they acted as an easy means of access of the water to the seams, which, forcing its way between the planes of bedding, would naturally tend towards the weathering and deterioration of the coal. Many hundreds of tons were obtained from these drives, and were sent away in small schooners which could come up the Burrum River as far as the thick beds of sandstone which form the barrier on which the Maryborough and Bundaberg Road crosses. The next step towards development appears to have been the sinking of a few shallow shafts from 50 to 100 feet in depth, beyond the reach of floods, but close, of course, to the outcrops of the seams. Among these were the Howard, Beaufort, and Whitley Shafts on the western side of the river and Walsh's Shaft on the eastern side. It is only of late, since the starting of the Company's and Torbanlea Mines, that anything approaching true mining has gone on.

The country all through the district is remarkable for its flatness; in parts the principal watersheds even are scarcely recognisable. It is very thickly timbered with low stunted trees—chiefly wattle, grass-tree, ti-tree, honeysuckle, and bloodwood. The latter is usually employed in timbering the mines.

Accompanying this report are two maps. One, on the scale of 20 chains to 1 inch, comprises the whole area on which any work has been carried on, and shows the selections taken up. The other, on the scale of 2 miles to 1 inch, shows the positions of the outcrops of the various beds and seams of coal visible in the watercourses and other natural sections over the whole area traversed by me.

Overlying the coal-measures unconformably is a horizontal formation of far more recent date. Its lithological character varies very much in different places. In parts it consists of small particles and water-worn crystals of quartz cemented together with oxide of iron. In other parts it is a variegated red, white, and brown sandstone; while in others it is a very arenaceous clay, or loam, which in the neighbourhood of Salt-water Creek is used for brickmaking purposes. The formation varies, too, from 15 to 40 or 50 feet in thickness, and overlying, as it does, the coal measures, it is only where the rivers and creeks have cut deep channels through it that the underlying beds are exposed to view. There are, consequently, large tracts of country over which no information at all will be obtainable except by sinking or boring.

There is no evidence as to the exact age of this superficial deposit, for it contains, as far as I have been able to ascertain, no fossiliferous remains whatever; but from its lying undisturbed and in a horizontal position over so large an area, it must be of very recent date, and it probably belongs to the latter part of the tertiary period. It has, in places, much the appearance of having been thrown down as a loose coarse sand, the cementing materials having since been filtered in from above.

The next oldest rocks in the district are those which crop out at the town of Maryborough and are known as the "Maryborough Beds." They have been quarried, about 1 mile west-north-west of the railway station, by the Corporation for road metal, and by the Government, 2 miles further out in the same direction, for railway ballast. The rock quarried is a fine-grained light-brown or grey sandstone. These beds contain numerous shells, which have been named by Mr. R. Etheridge, F.R.S.,* and are considered by him to belong to the cretaceous period, and to occupy a position between the Gordon Downs and Flinders River series, which are also referred to in the same paper.†

At the Corporation Quarry the strata consist of light-coloured fine-grained sandstones, dipping 12 degrees to the north 35 degrees east.

About a mile and a-half further along the Gayndah Road, and close to the River Mary, about half-a-mile from what is known as the Copenhagen Bend of the river, is the first of the Government Quarries; the dip is about 7 degrees north 35 degrees east. The rocks showing are:—

	Ft.	in.
Broken sandstone	8	0
Grey fine-grained sandstone (fossiliferous)	2	0
Band of laminated sandstone	0	6
Grey sandstone (fossiliferous)	2	0
Band of laminated sandstone	0	8
Brown sandstone	6	0
Brown shaly sandstone	0	4
Greyish brown sandstone (fossiliferous)	7	6
Fine laminated grey shale	0	5
Grey sandstone (fossiliferous)	2	3
Shaly band	0	4
Grey sandstone (fossiliferous)	4	0
Black shale	0	10
Hard dark-grey laminated sandstone (fossiliferous)	2	4
Shale	0	2
Grey sandstone (fossiliferous)	1	9
Laminated argillaceous sandstone	0	8
Dark-grey sandstone	2	0
	41	9

A quarter of a mile further up, exposed in another quarry, dip 7 to 8 degrees north 35 degrees east, are:—

	Ft.	in.
Brown sandstone with band of carbonaceous shale	6	6
Black carbonaceous arenaceous shales (fossiliferous)	2	7
Soft yellow sandstone	6	2
Shale and soft carbonaceous sandstone	8	0
Coarse gritty sandstone	10	0
	33	3

Just a couple of hundred yards on the Maryborough side of the Copenhagen Bend, in a quarry, are showing 30 feet of grey sandstones, containing the ordinary fossils met with in these beds and also numerous hollow casts of Belemnites; below this is a thin bed of carbonaceous sandstone, and below this again 50 feet of brown and grey sandstones (fossiliferous); dip, 9 degrees north 35 degrees east. Just in the centre of the bend, in a small gully cut into the steep bank of the river, are exposed:—

	Ft.	in.	
Horizontal sandstone, consisting of small quartz crystals cemented together	16	0	
Soft argillaceous sandstone	9	0	Dip, 9 degrees north 35 degrees east.
Soft yellow sandstone	11	0	
Grey shale and nodular carbonaceous sandstone	10	0	
Black shales with bands of brown and grey sandstone	11	0	
	57	0	

* Quart. Journ. Geol. Soc., London. Vol. xxviii. p. 283. † These beds, from their fossil contents, have since been classified by Mr. R. Etheridge, Junr., as Upper Cretaceous.—W.H.R., 1901.

These beds, it will be noticed, dip in the same direction and have about the same angle of inclination as the coal-bearing beds of Saltwater Creek and the Burrum River; and as they are not seen again beyond this point, it is probable that there is a fault between them and the Burrum Series. Similar sandstones, too, with the characteristic fossils of the Maryborough Beds (*Leda elongata*, *Avicula alata*, *Nucula quadrata*, and *Cyprina expansa*), are met with in the Isis River, about a quarter of a mile south-west of the Maryborough and Bundaberg Road, with a dip of from 30 to 45 degrees to the east 40 degrees north; these beds, which overlie the coal strata, can be traced for about a mile up a gully running into the Isis about half-a-mile higher up, but are not met with in the river again.

I met with sandstones belonging to the same series containing the cretaceous fossils *Avicula alata*, *Leda elongata*, and *Nucula*, &c., &c, about 32 miles north-west of Bundaberg and about 10 miles south of Rosedale Station. Their dip was uncertain, but they were evidently overlying the coal-measure series which are exposed about 2 miles south in Litabella Creek, dipping 12 degrees to the north-east.

Next in descending order of time come the coal-bearing series of rocks. The coal measures consist of a series of fresh-water sandstones, shales, mudstones, and nodular ironstones, with seams of coal dipping at angles varying from 8 or 9 up to 20 degrees, the average dip being about 11 or 12 degrees. These beds extend from the coast some 20 miles inland to near the heads of the Burrum and Isis Rivers, where, dipping at a high angle, they are altered into a series of micaceous schists, and finally rest upon granite. From just north of Maryborough they extend to north of the Gregory and Burnett Rivers. Coal, too, has been met with south of the Maryborough Beds on the Tinana Creek, at Owanyilla, and near Miva. The longer axis of the coal measures, therefore, lies in a northerly direction. (Map I.)

With reference to the exact age of the Burrum Coal Field I am unable to speak definitely, for although there are numerous fossil plant remains, I found none very characteristic. Among those I found were species of *Sphenopteris* and *Thinnfeldia*, &c.

Mr. Gregory, in his report on the field,* refers to the finding of *Glossopteris* above the upper or Beaufort Seam of coal.† I was unable to find *Glossopteris*. The presence of *Glossopteris* would undoubtedly be strong evidence of the palæozoic age of the beds, as it is generally associated with a palæozoic fauna.‡

From the shale about 2 feet above the seam of coal now being worked by the Queensland Colliery Company, some mollusca (*Lamellibranchiata*) were discovered. These, I believe, are the first fossil remains of a fauna that have been found in these beds, and I have sent them to Mr. R. Etheridge, Junr., for his identification, and his report may throw some light on the question.‖ I am of opinion, however, that the Burrum Coal Field will prove to belong to the Mesozoic Carbonaceous Series.

In the course of the survey I traversed all the rivers, creeks, and gullies in the area comprised between the Gregory and Burrum Rivers, from the coast to their sources.

THE BURRUM RIVER.

The outcrops of the coal measures can, in most instances, only be seen at or near the time of low water. In the lower reaches of the river no sections are visible.

In Watson's or Salt Creek are thin-bedded brown sandstones underlying blue shales, in which is a thin seam of coal. These shales contain very numerous plant remains; their dip appears in places to be a little south of east, and again, a little higher up, south-west, but it is not very distinct.

Several sections and outcrops of seams of coal are visible in Maria Creek, which runs through the township of Howard into the Burrum River about a mile north of the railway bridge. About a quarter of a mile from the Beaufort Shaft, thick-bedded brown sandstone dipping to the east 35 degrees north 13 degrees. A quarter of a mile further along is another outcrop of sandstone. Again, about 10 chains further down is a thin seam of coal 4 inches thick, dipping 14 degrees east-north-east; immediately above it is dark-brown coaly shale, while below it is a thin band of fireclay.

Twelve chains lower down again, dipping 12 degrees to the east-north-east, are:—

	Ft.	in.
Alternative sandstone and shale	4	0
Shale with 2 inches of coal...	0	11
Brown sandstone	4	2
Nodular ironstone	0	3
Shale (with fern impressions) ... ... (thickness unknown)		
	9	4

One hundred yards further down a small shaft has been sunk on to a seam which, I am informed, was from 18 inches to 2 feet in thickness; a few tons of coal were taken from this shaft and also from a drive in the bank. In the creek are exposed:—

	Ft.	in.
Brown sandstone ... ...(thickness unknown)		
Black carbonaceous shales	2	0
Alternate sandstone and shale	7	4
Coal	2	0
Fireclay	0	4
	11	8

Two hundred yards further along is a seam of coal, 2 inches thick, in brown carbonaceous shale.

* Report on the Burrum Coal Mines, by A. C. Gregory, Queensland, 1879.

† This has since been determined to be a form of *Tæniopteris*.—W.H.R., 1901.

‡ The Burrum Beds have since been classified by Mr. R. Etheridge, Junr., as Lower Trias-Jura.—W.H.R., 1901.

‖ These fossils were *Corbicula burrumensis*, a species of Unio, and *Rocellaria terra-reginæ*—W.H.R., 1901.

Fifty yards further down are thick-bedded sandstones. From this point, for the next 5 chains, the strata gradually bend round from dipping north-east to the north-west, and in the beds dipping north-west are two thin seams of coal.

	Ft.	in.
Conglomerate and sandstone	5	0
Blue shale	1	2
Sandstone	5	3
Coal	0	3
Shale	1	3
Coal	0	4
Fireclay	0	3
Sandstone ... ... (thickness unknown)		
	13	6

Immediately below this point, again, the rocks have their ordinary dip of 10 degrees east-north-east. A small fault seen in the bed of the creek accounts for this sudden change in the direction of dip Nothing can be seen in the river between the mouth of Maria Creek and about 5 chains below the railway bridge, where a bed of thick-bedded coarse grey and brown carbonaceous sandstone (40 feet thick) form a bar across the river. Next, and underlying them, comes a thickness of softer sandstones and shales, and immediately underlying these is a seam of coal, which is now concealed by the mud; it was discovered in the western bank of the river in digging out a sunken punt. This seam was intersected when sinking the tubes in making the railway bridge. I could get no information as to its thickness. The dip of the strata here is 12 degrees east 37 degrees north. What is probably the same seam is seen 3½ chains above the bridge, where two seams of coal crop out in a small cutting in the eastern bank, which are known as the "Bridge Seam." Of the underneath one only the top was visible. I am informed, however, that it is 3 feet thick. Above it are nearly 5 feet of black carbonaceous shales, and the upper seam 2 feet 7 inches thick, the whole of which can be plainly seen in the bank. Immediately overlying it are dark-brown shales. Three chains above this again, in a small steep gully in the bank, is a small seam of coal 3 inches thick underlying brown sandstone. From that point for the next 8 chains nothing can be seen in the river except a small outcrop of sandstone; here another steep gully enters the river in which two seams of coal are exposed to view—one a couple of inches thick, the other about 10 inches thick, in shales with thin bands of brown sandstone.

Five and a-quarter chains higher up, again, is the outcrop of the "Lapham or Torbanlea Seam." Between the Bridge Seam and the Lapham Seam, therefore, there are about 220 feet of shales with a few thin beds of sandstone, and containing thin seams of coal. The small cutting in the bank by which this seam was reached is filled up. I was informed, however, that it was 2 feet thick, with a band of shale in the middle 4 inches thick.

Two and three-quarter chains above, the "Burrum Seam" crops out in the bank. This seam lies here about 35 feet below the Lapham or Torbanlea Seam. It is 3 feet 7 inches thick, and dips 12 degrees to the east 38 degrees north. This seam was originally worked by means of a drive put in on it from the river bank. Afterwards a shaft was put down by Mr. Walsh, about 80 yards from the river bank, to a depth of 40 feet. A tramway was laid from the shaft to the river and terminated in a "shoot," so that the coal could be shot at once on board the schooners. The shaft was situated too near the river which forms the boundary of Mr. Walsh's ground, and it was not sufficiently far to the dip of the coal, for it cut the seam right on its outcrop so that all the workings were to the dip. These workings have been closed for some time past. A borehole, put down 220 yards east 35 degrees south of the outcrop in the river, cut the seam at 64 feet This seam, and the Lapham and Bridge Seams, as well as seams underlying these, have been traced by Mr. Robertson by means of boreholes for 2 miles in a south-easterly direction right into his ground. He put down a first series of 5 boreholes 1 mile to the south-east. The strata these boreholes (marked 1, 2, 3, 5, and 6 on Map No. 1) passed through are given in the Appendix A attached to this report; it will be noticed that passing in their order from the dip to the rise, that first thick sandstones occur, then a seam of coal (probably the Bridge Seam), then shales and thin beds of sandstone with thin seams of coal, and then again two seams 25 feet apart (the Lapham and Burrum Seams), thus corresponding very closely with what was passed over in the bank of the river. Again, a little less than a mile further on in the same direction, a second series of boreholes, marked 6 to 12, were put down, in which the same order of strata occur, and the same series of coal are cut. Mr. Robertson's Torbanlea Mine is on the Burrum and Lapham Seams. I shall, however, have to refer to these workings further on.

Returning to the river, on the western bank, just opposite to Walsh's Pit, a shaft (known as Joss's Shaft) was sunk, and cut a seam of coal 2 feet thick at a depth of 70 feet; from the position which was pointed out to me, however, it ought to have passed through the Burrum Seam long before it reached that depth, unless there were a fault here in the direction of the river. If there is a fault it can only be a small one, for otherwise the Watson and Hartley Seams would not have been met with where they are in the boreholes above referred to. I could not get any very reliable information about this shaft either as to its exact position or what strata it passed through.

About 5 chains higher up the river, a thin seam of 10 inches is showing; and then again, 6 chains higher up still, the Watson Seam of 4 feet of coal is plainly visible in the bank. A large quantity of coal was shipped away from this some years ago. This seam, too, was cut in one of the boreholes on Mr. Robertson's Ground. The Watson Seam lies about 152 feet below the Burrum.

Proceeding up the river, thick-bedded carbonaceous grey and brown sandstones, with a few beds of shale, are met with. These sandstones are seen in a small creek on the eastern side of the river, and again in the bend of the river, where the direction of both their outcrop and strike are coincident with the direction of the river. These sandstones, with their thin beds of shale, are about 400 feet thick, Near the top of these sandstones, in the western bank of the river, a seam of coal 18 inches thick, with a fireclay floor, dips 13 degrees to the east 40 degress north. Twenty-seven feet below this is another seam, the total thickness of which cannot be seen. I was informed that it was 2 feet 6 inches thick; the thickness exposed to view is 16 inches. Fourteen feet of sandstones lie below this, and then

comes the North Hartley Seam, 4 feet 2 inches of coal without a band. This seam was worked for some time by means of a drive in the river bank; it is about 270 feet below Watson's Seam. A borehole on the eastern side of the river cut this seam at 55 feet. A seam of coal 10 inches thick lies a few feet below the Hartley Seam. Beneath this again are 200 feet of sandstone, still dipping 13 degrees east 40 degrees north, in which are three thin seams of coal of from 2 to 4 inches in thickness; these thin seams are exposed in a gully on the western side of the river; and then comes a seam which can be seen in the sandstone at the crossing of the Bundaberg Road, situated near the base of this series of sandstones. This seam is here about 20 inches in thickness, and is probably the Glenesk, which has been worked about a mile and a-half from here in a north-westerly direction, where it is about 2 feet thick. I was unable to get any particulars as to what rocks were passed through in sinking the Glenesk Shaft. (Fig. 2, Plate II.)

From this point, for a mile and a-half up the river, nothing is to be seen but, here and there, thick beds of sandstone which outcrop and form bars across the stream. Their positions are shown on the map. Their average dip is about 13 degrees to the north-east; they contain thin beds of shale and layers of nodular ironstone. Beds of shale and soft sandstone in all probability occupy most of those parts where no section is visible. In a gully in White's Paddock sandstones crop out, and have been quarried for building purposes. A mile and a-half from the crossing, sandstone about 240 feet thick crops out.

At this point a small gully runs into the river on the western side, just above the southern boundary of White's Selection, in which some seams of coal are exposed. The top one, about 4 chains from its mouth, is 4 inches thick and is overlaid with sandstone and shale. Below this come 40 feet of strata which cannot be seen, and then a seam of coal 1 foot 4 inches in thickness, on which a small tunnel has been driven; below this is 4 feet of clay and another seam of coal 1 foot 3 inches thick.

A quarter of a mile lower down the gully another seam of coal 1 foot thick crops out in the bank; this seam has also been driven on.

For about three-quarters of a mile up the river from this point the only thing visible is the outcrop of a brown sandstone; then in a gully on the western side of the river a seam of coal is visible, in a waterhole, 7 inches thick; it is dipping 14 degrees to east 42 degrees north and overlies carbonaceous sandstones and thin shales; 3 chains higher up the gully are hard grey sandstones. Eight chains south-west of this a seam of coal is seen in a drive in the bank, some few yards from the river; it is 1 foot thick. This is close to the most southerly point of Map No. 1. As all the workings are included within the area comprised in this map, I will briefly describe them here before going on to a description of the structure of the other parts of the field.

TORBANLEA MINE.

On the eastern side of, and about 2 miles from, the Burrum River in a south-easterly direction is Mr. Robertson's Torbanlea Mine. This is the only pit at work on this side, Walsh's Pit having been abandoned some time ago. The pit, which is 10 feet by 5 feet, is sunk through the Lapham or Torbanlea Seam down to the Burrum Seam, cutting the former at 85 feet and the latter at 110 feet in depth. It is situated about a mile south-west of the railway, and a private line has been constructed to connect it therewith.

Work was first started on the lower or Burrum Seam, but it has been abandoned for the time being in order to work the Lapham Seam, which is reached by a crosscut put in from the former. The Lapham is a harder and better coal, especially for gas-making purposes. The Burrum Seam here is 3 feet 11 inches thick with a band of shale 7 inches thick. (Fig. 3, Plate I.)

The roof is a grey shale and is fairly good. The coal is friable.

The Lapham Seam is thicker and is a more solid and brighter coal. It is 6 feet 2 inches in thickness, including a band of black carbonaceous shale 1 foot 3 inches thick in the middle. It has therefore increased greatly in size from the place where it is seen in the river bank, where it was only 2 feet 4 inches thick, and it is, I learn, still increasing in thickness towards the south-east. (Fig. 4, Plate I.)

The roof is of black shale, with numerous shining slippery faces, known as "slickensides," which render it somewhat dangerous; and great care is necessary to prevent accidents from falls of the roof.

The average direction of the levels, or what may be taken as the direction of the strike of the seam, is north 37 degrees west; the dip varies from 1 in 4 near the outcrop, to 1 in 6 in the lowest levels. This high angle of dip is one of the drawbacks to the field, rendering the working more expensive, and also carrying the coal to a great depth in a comparatively short distance. The method of work is the "Pillar and Bord," the principal roadways being driven to the dip with the intention of working away the pillars to the rise.

The present shaft being to the rise of the workings, it is necessary to have two "lifts" both for the coal and for the water; and its being close to the boundary of the property the levels can only be advanced in one direction—viz., to the south-east. The mine has thus, up to the present, been worked under great disadvantages; but Mr. Robertson is now sinking a new shaft some distance to the dip of the present one, and in the middle of his property, which will enable him to develop the mine on a larger and more economical scale. The present output of the mine is about 800 tons a month.

Experiments conducted at Melbourne prove this to be a good steam-coal. Two tons of coal evaporated 3,900 gallons of water, whereas two tons of the best Newcastle Coal (New South Wales) evaporated only 3,200 gallons of water, or in a ratio of $8\frac{3}{4}$ to $7\frac{1}{4}$. Complaints have been made as to the friability of this and other Burrum Coals; but this is almost universally the case with seams of coal near their outcrop, and they will undoubtedly improve in this respect at lower depths.

THE QUEENSLAND COLLIERY COMPANY'S MINE.

This mine is situated on the north side of the river, about 50 chains slightly west of north of the Howard Railway Station. The shaft is 10 feet by 10 feet, and is 220 feet deep. In sinking it passed through several thin seams of coal, including one 2 feet thick at a depth of 63 feet. Particulars of the strata passed through in this shaft are given in the Appendix A.

The seam being worked varies very much in thickness. (Fig. 5, Plate I.) The roof very bad. It is of shale with "slickensides." The floor is of fireclay.

The dip varies greatly both in amount and direction, from almost nothing up to as much as 1 in 3½; the average being about 1 in 5 to east 34 north. The average strike of the seam being north 34 west.

The method of work has been the "Pillar and Bord." Mr. Rankin, the manager, is now trying the "long wall" system at the end of the north-westerly level, where the coal is 3 feet 6 inches without any band.

Several small faults have been met with. One in the north-westerly level runs in a north-east direction and displaces the seam 4 feet, the displacement increasing towards the dip. Another to the rise of the pit, out towards Whitley's Shaft, runs in an easterly direction, the amount of down-throw of which is not known. The seams on this side of the river appear to be more disturbed than those on the south side; for several small faults were met with in Whitley's Mine, and also in working the Beaufort Seam.

The output is 1,500 tons per month. This will soon be greatly increased, as the levels, which were much too low to allow of a large output, are now being enlarged. The winding plant is a very fine one, and is equal to a very greatly increased output. As this and the Torbanlea Mine are the only two at work, the output for field only reaches 2,300 tons per month.

WHITLEY'S SHAFT.

This is on the same seam as, and is 14 chains south 30 degrees west of, the Company's Shaft. The seam here was 6 feet thick with bands of shale, or about 3 feet 6 inches of coal. It was cut at 110 feet in depth, just in the middle of a small "trough" fault which displaced the coal about 34 feet and 6 feet (*see* sect. of fault, Fig. 6, Plate III.) A borehole, 5 chains off and 1½ chains to the rise, cut the seam at 84 feet. The workings have been abandoned, the seam being now worked from the Company's Shaft.

THE BEAUFORT AND HOWARD SHAFTS.

These were put down about a mile south-south-east of the Company's Shaft to depths of 50 and 51 feet respectively, on what is called the Beaufort Seam, which lies probably above the seam worked by the Company. It is 4 feet 5 inches thick with only a thin band of shale. This seam was also worked for some time by a tunnel driven in on the seam in the direction of its dip, and a large quantity of coal taken out.

A shaft called the "Briton Shaft" was sunk 18 chains to the dip of these, with the intention of cutting this seam at a greater depth, but was abandoned at the depth of 320 feet. Allowing an average dip of 12 degrees, which is above the average rather than under, this seam ought to have been met with at a depth of just under 300 feet. It is probable, therefore, that there is a fault in a north-westerly direction accounting for the absence of the coal. A seam of coal 1 foot 6 inches thick was cut at 170 feet. Analyses of the coals from some of these seams are given in Appendix B.

THE GLENESK MINE.

About a mile to the south-west of the Company's Shaft, a shaft has been sunk 100 feet in depth on to a seam called the "Glenesk." The coal is from 18 inches to 2 feet in thickness. The country passed through in the shaft consists of hard grey and brown sandstones. The Glenesk Seam is probably the same as that seen in the Burrum River at the crossing of the Bundaberg Road, as it corresponds in direction with it, and that seam, too, is interbedded in grey and brown sandstones.

At present there is no sufficiently clear evidence to enable the various seams on either side of the river to be identified. Unfortunately, except in the case of the sinking of the Queensland Colliery Company's Shaft, no records were kept of the strata passed through; and work having been stopped, the shafts of the other mines on this side of the river are full of water, preventing an examination of the seams.

The Company's Seam has generally been considered to be identical with the Burrum Seam, seen in the river bank. This can scarcely be the case, for the Lapham Seam, which lies a few feet above the Burrum Seam, would be missing. It may, however, be the Lapham Seam, and the thick series of shales with thin bands of sandstone and thin beds of coal would, to a certain extent, bear out this supposition.

Continuing up the Burrum River from the point where we left off, no section is met with till the junction of its branches—Stony Creek and Duckinwilla Creek—is reached. Here there are about 100 feet in thickness of alternate brown and grey sandstones and shales; the shales containing thin leaf-like layers of coal and also bands of clay ironstone. The dip is 12 degrees to east 42 degrees north.

Beyond this there is no section for some miles. At the junction of Powell's Creek with Stony Creek, black shales with thin bands of brown sandstone dip 9 degrees to north 20 degrees east. The overlying horizontal sandstone met with in the neighbourhood of the Burrum is about 30 feet thick here.

Following up Stony Creek, opposite Warrah Paddock, there is a hardened altered sandstone dipping 35 degrees to north-east. A mile further up quartzite dips 40 degrees to the east. A mile further up again, just opposite Forbes's Creek, 3 feet of very hard brown sandstone overlies a soft yellow sandstone; dip, 30 degrees to east 30 degrees north.

In Forbes's Creek, 7 chains above the junction, a section of thin-bedded carbonaceous sandstones lies between massive hard grey sandstones; dip, 32 degrees to east 10 degrees north. A few yards further up, laminated shales dip 35 degrees to the north-east.

Half-a-mile further up Forbes's Creek very hard brown sandstones, with a bed of bluish shale 1 foot 6 inches thick, dip 35 degrees to north-east. Just beyond this point, and also in Stony Creek, quartzites occur abutting on a syenitic granite, which can be seen in both creeks.

In Lagbridge Creek very few sections are exposed. For about 3 miles below the road are hard altered sandstones with a dyke of felsite running nearly north and south. Above the Gayndah Road the altered sandstones still continue, and they are in places very calcareous.

In Powell's Creek, about a mile above Lower Doongul Station, in a small gully, dipping 40 degrees to north 35 degrees east, the following rocks are seen :—

	Ft.	in.
Greenish micaceous sandstone	4	0
Fine-grained grey carbonaceous shale	1	5
Greenish and brown sandstone	2	8
Banded carbonaceous sandstone and nodular ironstone	1	6
	9	7

A quarter of a mile higher up this gully a hard flinty whitish sandstone dips 35 degrees to south 10 degrees west.

In a quarry half-a-mile further up, near the Gayndah Road, are sandstones which have been quarried for road metal. This quarry shows 60 feet of whitish hard sandstones, argillaceous in parts, and with a band of grey shale 18 inches thick; they dip steeply to east-north-east. These sandstones, coloured red in parts by the infiltration of oxide of iron, as far as I could see, contained no fossils.

Immediately underlying these, and exposed in a cutting in the road, are :—

	Ft.	in.	
Grey shales with bands of brown sandstone	90	0	Dip, 45 degrees east-north-east.
Grey and whitish sandstones	177	0	
Break in section	24	0	
Carbonaceous shales with bands of sandstone	30	0	Dip, 40 degrees east-north-east.
Soft dark-coloured shales	3	0	
Hard greenish sandstone	12	0	
Break in section	60	0	
Sandstone with layers of shale	6	0	
Coarse grey sandstone	7	0	
Fine-grained laminated sandstone	7	0	
White argillaceous sandstone	8	0	
Blue carbonaceous and micaceous shales with thin bands of brown sandstone	16	0	Dip, 35 degrees east-north-east.
	438	0	

A mile further up Powell's Creek a calcareous sandstone dips east-north-east, and a quarter of a mile again dips 18 degrees to east-north-east. This sandstone is mottled red and white.

Immediately south of this point granite is met with.

THE CHERWELL CREEK.

The Cherwell Creek is reached about 4 miles north-west of Howard. It runs in a north-easterly direction into the Burrum River. The country between Howard and the Cherwell is very flat, and being covered with the overlying sandstone formation, no information as to the structure of the country can be obtained.

Starting from a point about a mile below the crossing of the old Bundaberg Road, a seam of coal was cut in sinking a well on the north side of the river. The thickness of this coal was never ascertained owing to the water rising so quickly in the well immediately the coal was struck.

On the opposite side of the river from this well a seam of good hard coal, of unascertained thickness, can be seen in the water. Large lumps can be detached. From their relative positions it is probable that this seam overlies the one that was discovered in sinking the well.

Going up the creek, brown sandstones are lying immediately underneath this seam. Dip, 6 degrees to east 30 degrees north.

Some half-a-mile further up the creek, at what is known as the lower crossing of the old Bundaberg Road, grey and brown standstones cross the creek, and dip very slightly to east 20 degrees north.

Just a quarter of a mile above this again, a seam of coal crops out in a waterhole.

Higher up again, at the upper crossing of the road, are sandstones lying quite flat.

For some distance, about a mile above this, no section is showing. Then in a waterhole there is an outcrop of a seam of coal. It is covered with water, and its thickness is not known; but it must be at least a foot thick, as large cubical pieces, with sides of over a foot in length, have often been picked up.

About one-third of a mile further up, brown sandstone and a bed of ironstone dip to the south-west.

A quarter of a mile further up again, a small seam of coal 5 inches thick dips 11 degrees to the south-west; and 4 chains beyond this are black shales with very thin leaf-like layers of coal—dip 13 degrees to south-west.

Passing across from the creek to a small branch creek, which runs in a north-easterly direction into the Cherwell a mile or so below this point, about a mile up this branch creek, yellow and grey thick-bedded carbonaceous sandstones outcrop in the bank, and are dipping 11 degrees to the south-west.

About half-a-mile further up this creek it divides into two branches, one of which—the left-hand one—forms a string of waterholes. In one of these waterholes, just above the junction, a seam of coal, said to be 2 feet thick, crops out, but only the surface of it was visible in the mud. A second seam of coal lying below this one, and 1 foot in thickness, in beds of dark-brown shales, can be seen in the right-hand branch just a few yards below its junction, dipping 11 degrees to south-west.

THE ISIS RIVER.

The Isis River runs east-north-east into the Burrum River, about 2 miles above the mouth of the Cherwell Creek.

At its junction with the Burrum are yellow sandstones.

For a mile and a-half no section is seen, and then in the south bank is a brown sandstone, the dip of which is uncertain.

A mile above this, where the river bends at right angles to the south-south-west, the dip of the sandstone is 8 degrees to east 20 degrees north. Just about 100 yards above this are carbonaceous sandstones lying very flat.

A mile beyond this are cliffs, about 40 or 50 feet high, of the horizontal sandstone formation on the south side of the river.

For some distance beyond this there is no section at all. Then 300 yards above the upper island, and three-quarters of a mile below the rafting ground, is a grey impure sandstone with layers of shale. Dip, 6 degrees to east 20 degrees north.

	Ft.	in.
Grey sandstone	4	0
Brown shales	3	0
Ironstone	0	3
Dark-brown carbonaceous shales	2	0
	9	3

A third of a mile below this a seam of coal 3 inches thick was cut in a shaft on the south side of the river at 15 feet in depth.

Half-a-mile above the last section a bed of grey sandstone crosses the river. Dip, 15 degrees to east 25 degrees north.

Ten chains again above this, at the boundary of the rafting ground, greenish-grey hard sandstone dips north-east; and immediately above this, about 100 yards, at the lower crossing of the old Bundaberg Road, conglomerate, shale, and sandstone dip 9 degrees to west 20 degrees south.

A third of a mile further up the river is an outcrop of black carbonaceous shale and coal in the north bank. A borehole was put down to cut this. It consisted of black shale with thin leaf-like layers of coal, not the eighth of an inch in thickness.

A third of a mile higher up hard grey carbonaceous sandstones dip 10 degrees to the south-west.

A quarter of a mile higher again is a bed of grey sandstone crossing the river. Dip, south-west.

Sixteen chains higher up is a shale containing a large percentage of coal mixed with it in thin layers; and a chain above and overlying this is a grey carbonaceous sandstone. Dip, west 22 degrees south.

Thirteen chains above this again a bar of sandstone, extending 9 chains, with an average dip of 9 degrees to west 22 degrees south. This would represent a thickness of nearly 100 feet of sandstone.

A little over a mile higher up, dipping 18 degrees to west 20 degrees south, are :—

	Ft.	in.
Brown sandstone	6	6
Black shale	3	9
Brown sandstone	13	0
Brown shale	4	7
Grey carbonaceous sandstone	22	7
Coal	0	4
Black coaly shale	14	9
Brown sandstone	13	0
Coaly shale	3	9
Brown and grey sandstone	46	6
Grey shale	1	10
Brown shale	6	6
Brown sandstone and nodular ironstone	16	9
Brown sandstone with layers of shale	11	7
	165	6

About a mile and a-half above this, dipping 16 degrees to west 35 degrees south, are :—

	Ft.	in.
Greyish sandstone	2	10
Coal	0	2
Black and grey banded shale	1	0
Coal	0	1
Grey arenaceous shale	2	4
Coal	0	3
	6	8

A quarter of a mile above this is a banded sandstone and shale. Nothing more is visible in the river until after crossing the Bundaberg Road, a distance of over 4 miles.

About a chain above the road, a brown sandstone dips 35 degrees to east 30 degrees north. This is seen again in the high bank 4 chains higher up.

About 15 chains further up are the fine-grained sandstones containing Cretaceous Fossils, already referred to in this report. They dip 50 degrees to east 40 degrees north, and are exposed to view for a quarter of a mile.

Half-a-mile above the road a gully runs in on the south side of the river. Six miles from its junction, a black fossiliferous shale dips 30 degrees to east 40 degrees north. For a mile up this gully sandstones and shales, containing cretaceous fossils, occur.

Two miles from here the Isis River branches into two creeks—Oakey Creek, and Agnes Vale or Broom's Creek.*

A thin seam of coal is visible in a gully about a mile up Oakey Creek.

Half-a-mile up Broom's Creek, dipping 45 degrees to east-north-east, are alternate beds of brown sandstone and shales; and only a chain higher up, dipping 26 degrees to east 10 degrees north, are:—

	Ft.	in.
Alternate sandstones and shales	10	0
Coal (with a thin band of shale)	0	8
Sandstone and shales	50	0
	60	8

A mile further up a bed of coal 4 inches thick occurs in shale.

Close to the junction of Rocky Creek are thick-bedded brown sandstones. Dip, 20 degrees to the north-east.

A mile above this point, dipping 16 degrees to north 10 degrees west, a section 30 feet thick of alternate carbonaceous sandstone and shales, with a seam of coal 4 inches thick. In a waterhole only about 20 yards off the sandstones dip north 30 degrees east.

Following up the creek for the next 4 miles, very little can be seen with the exception of, here and there, hard altered sandstones, with conglomerate and shales, dipping steeply to the east or thereabouts. At this point a small area of about 4 square miles of granite is passed over.

The country to the west, and all the way up the creek, consists of highly inclined metamorphic rocks, consisting chiefly of micaceous slates and altered sandstones, with, in places, quartzite and gneiss. These rocks contain small veinlets of quartz. These rocks rest on granite.

Close to Agnes Vale Station, about half-a-mile to the south-west, is a reef or lode, on the cap of which there is copper-stained quartz.

Four miles below Agnes Vale Station are perpendicular dark-coloured micaceous slates.

A mile higher up the creek is a hard micaceous sandstone.

Half-a-mile again is a fine-grained brown sandstone.

Half-a-mile further up, a gneiss and micaceous slate.

Again, half-a-mile, a dyke of granite crosses the creek in a direction a little north of west.

A mile above Agnes Vale, a quartz reef crosses the creek in a north-west direction.

Three-quarters of a mile above this, staurolite micaceous slate dips steeply north-east.

Half-a-mile higher up, gneiss quartzite and micaceous slate are seen dipping steeply north-east in the high bank of the creek.

Half-a-mile further up micaceous slate dips steeply to the east.

Just north of Broomfield an altered sandstone dips east; and from here to the summit of the range, the country is micaceous slate.

On the road from Agnes Vale to Stanton Harcourt, for 2½ miles, micaceous staurolite slates are passed over; dip, steeply to east. At this point the slates are bounded by the granite.

On the road from Agnes Vale to Doongul, a mile from the station, are whitish argillaceous and brown micaceous sandstones dipping steeply to the east 20 degrees north.

A mile and a-half further along, light-grey micaceous sandstone dips steeply west 25 degrees south.

In a road-cutting at the point where the Agnes Vale road joins the Gayndah Road, white and brown sandstones with bands of grey shale dip steeply to east 15 degrees north.

About a mile further on, a thick-bedded brown and grey sandstone, containing numerous markings of the stems of plants, dips 55 degrees to west 20 degrees south. A quarry shows 30 feet of them.

A mile further along the road, mottled sandstones dip 50 degrees west 15 degrees south.

A little over a mile again, brown sandstone with blue shales dip 50 degrees to west 25 degrees south.

Half-a-mile further on are argillaceous sandstones.

One mile beyond this is a long cutting in the road on the top of the range. For the first 200 yards a hard sandstone, containing a small intrusive sheet of diorite, dips 60 degrees to the south-west. Beyond this to the end of the cutting, which is over half-a-mile long, fine-grained micaceous laminated sandstones dip from 55 to 60 degrees to the south-west.

Half-a-mile beyond this point the granite is met with again.

THE GREGORY RIVER.

The Gregory River runs in an easterly direction into the Burrum River, which it joins about 3 miles above the mouth of the Isis. From the crossing of the Maryborough and Bundaberg Road there is no section for over 3 miles down the river. Just opposite Messrs. West and Blisset's Sugar-mill (Goodwood Mill) a bed of black shale 16 inches thick, with a thin band of fireclay in the middle, is full of thin leaf-like layers of coal, and dips 14 degrees a little south of west.

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* To the north-west of this point is an area of basalt known as the Isis Scrub. This area since my visit has been cleared of the scrub, and the land has proved most suitable for the growing of sugar-cane, which has become quite a large industry here. In the latter end of 1899 Mr. L. C. Green mapped the area of basalt and volcanic tuffs in this neighbourhood, and his work has been plotted on Map No. 2.—W.H.R., 1901.

Half-a-mile lower down in a waterhole, drift coal has been picked up in large blocks often over a cubic foot in size. This coal was of good quality, and for some time was carted away by a blacksmith for use in his forge. The exact position of the seam has not yet been found, as its outcrop is concealed by drift and mud.

A mile further down the river, dipping 15 degrees to west 20 degrees south, are:—

	Ft.	in.
Coarse brown sandstone	6	0
Fine-grained sandstone	0	6
Fireclay	0	2
Coaly shale	0	6
	7	2

A quarter of a mile lower down, where the present (private) coach road to Bundaberg crosses the river, there are thick beds of brown and grey carbonaceous sandstones, with bands of ironstone. Dip, 18 degrees to west 20 degrees south.

No section is visible for the next 6 miles. This is to a great extent due, I believe, to all the waterholes having been completely filled by a recent thunderstorm, and thus concealing outcrops of rock that otherwise would have been visible.

Six miles lower down very hard grey and brown carbonaceous sandstones dip 14 degrees to south-west. These sandstones form a series of bars across the river at low water, and are 400 feet thick.

A mile lower down again, below the junction of Stockyard Creek, two bars of similar coarse-grained sandstone dip 12 degrees to the south-west.

Following up Stockyard Creek near its mouth the same thick beds of sandstone, which were seen in the river, cross the creek. Dip, 10 degrees to west 40 degrees south.

Half-a-mile from its junction with the river, sandstone dips 10 degrees to west 25 degrees south.

No further sections could be seen in this creek with the exception of two places: the first, 4 miles from the town of Abington on the Bundaberg Road, where sandstones, with a few badly preserved fern impressions, dip 10 degrees to the south-west; and the second, a mile and a-half further up the creek, where brown carbonaceous sandstones, dipping south-west, overlie grey shales. To the west of the town of Abington and the Bundaberg Road is the Isis Scrub. The scrub is on a red volcanic soil. In sinking wells in the scrub the coal measures have been reached, and in one case a thin seam of coal was pierced.

It will be noticed, in the descriptions just given of the rivers and creeks north of the Burrum River, that although numerous thin seams of coal varying from 1 to 18 inches in thickness crop out from time to time, yet no seams of workable thickness are exposed to view, as is the case in the latter stream. This, however, is by no means proof that such seams do not exist; for, as has been shown, the thickness of the rocks whose outcrops are exposed to view in these watercourses form but a very small proportion of the total thickness of the coal-bearing rocks existing, long distances being traversed without any section being seen. There is every probability that seams of coal, of sufficient thickness to pay to work, do exist in this northern part of the field; but they will only be discovered by the putting down of a series of shafts or boreholes.*

NOTE.—Since writing this report the following fossils have been described by Mr. R. Etheridge, Junr., from the Burrum and Maryborough Beds.—W.H.R., 1901.

LIST OF FOSSILS FROM THE BURRUM BEDS. (Lower Trias-Jura.)

PLANTÆ.

FILICES—
Sphenopteris flabellifolia, var. *erecta*, T. Woods.
Trichomanites laxum, T. Woods.
Thinnfeldia media, T. Woods. ?
Tæniopteris, sp. ?
Alethopteris australis, Mowr.
Phyllopteris Fiestmanteli, Eth fil.

PLANTÆ—*continued.*

CYCADACEÆ—
Podozamites Kidstoni, Eth. fil.
,, *sp. ind.*
Otozamites, ? sp. ind.

CONIFERÆ—
Baiera bidens, T. Woods.

ANIMALIA.

Corbicula burrumensis, Eth. fil.
Rocellaria terra-reginæ, Eth. fil.

LIST OF FOSSILS FROM THE MARYBOROUGH BEDS.

ANIMALIA.

ECHINOIDEA—
Micraster Swecti, Eth. fil. (sp. nov.)

PELECYPODA—
Lima (Radula) Randsi, Eth. fil.
,, *sp. ind.*
Pseudavicula ? alata, Eth.
Maccoyella corbiensis, Moore.
,, *reflecta*, Moore.
,, *substriata*, Moore.
,, *umbonalis*, Moore.
Cucullæa robusta, Eth.
Nucula quadrata, Eth.
,, *gigantea*, Eth.
Nuculana (? Yoldia) Randsi, Eth. fil.
Adrana elongata, Eth.
Trigonia nasuta, Eth.

ANIMALIA—*continued.*

PELECYPODA—*continued.*
Trigonia, sp. ind.
Cyprina Clarkei, Moore.
Unicardium ? Etheridgei, Eth. fil.
Palæomæra mariaburiensis, Eth.
,, *? sp. ind.*
Glycimeris sulcata, Eth.
,, *rugosa*, Moore.
Ceromya, ? sp. ind.
Lutraria, sp. ind.

GASTEROPODA—
Natica variabilis, Moore.

CEPHALOPODA—
Belemnites, sp. ind.

*NOTE.—Up to the present time no coal has been worked on the Burrum Coal Field north of the Queensland Colliery Company's Mine, Howard—W.H.R., 1901.

APPENDIX A.

BOREHOLES.

No. 5.

	Ft.	in.
Surface formation	21	0
Yellow sandstone	3	0
Grey sandstone	2	8
Yellow sandstone	4	10
Grey sandstone	26	0
	57	6

No. 6.

Surface formation	19	0
Yellow and grey sandstone	19	0
Brown and blue shale	12	0
Grey shale	1	4
Dark coaly shale	13	11
*Coal	1	6
*Dark coaly shale	11	11
*Coal	0	5
*Dark coaly shale	3	2
*Coal	2	0
Coaly shale	6	3
	86	6

No. 1.

Surface formation	18	9
Brown shale	10	3
Grey and blue shale	11	0
Ironstone	1	0
Grey shale	4	0
Grey sandstone	11	0
Ironstone	3	3
White clay	0	6
Grey sandstone	6	9
Dark shale	3	0
Coal	0	3
Dark coaly shale	2	9
Ironstone	0	6
Fireclay	2	0
	72	0

No. 2.

Surface formation	26	8
Grey shale	7	10
Dark coaly shale	10	6
Coal	1	7
Band	0	3
Coal	0	4
Coaly band	1	2
Coal	0	4
Dark shale	2	10
Grey shale	9	6
Dark coaly shale	1	3
Coal	0	9
Coaly shale	0	6
Coal	0	9
Dark coaly shale	6	3
Dark-grey shale	4	6
Coal	0	7
Grey sandy shales	12	11
	88	6

No. 3.

Grey sandy shale	19	0
Surface formation	27	6
Light mottled shale	3	3
Dark coaly shales	4	4
Coal	0	5
Coaly shale	0	8
Grey shale	3	2
†Green sandstone	1	1
†Dark coaly shale	1	9
†Grey shales	17	1
	59	3

No. 9.

Surface formation	21	8
Brown shale	2	8
Light-grey shale	2	0
Coal	0	3
Grey coaly shale	4	2
Coal	0	3
Dark coaly shale	5	10
Coal	0	5
Dark coaly shale	4	3
Coal	0	2
Dark coaly shale	2	10
Grey sandy shale	5	3
	59	0

No. 10.

†Surface formation	16	6
†Yellow and grey sandstone	8	6
†Hard grey sandstone	16	6
	41	6

No. 11.

†Surface formation	12	0
†Hard yellow and grey sandstone	33	1,0
Dark coaly shale	2	2
*Coal	1	10
*Coaly shale	0	5
*Coal	0	3
*Dark shale	7	8
*Coal	0	3
Grey coaly shale	2	1
Grey sandy shale	6	0
	66	6

No. 12.

Surface formation	17	0
Brown shale	1	0
Coal	0	8
Brown coaly shale	0	4
Coal	0	3
Brown coaly shale	1	7
Coal	0	3
White clay	0	11
Grey shale	9	6
Sandy shale	9	0
Coal	0	3
Grey shale	3	3
Dark coaly shale	2	9
Coal	1	1
Dark coaly shale	4	8
Coal	0	4
Dark-grey sandy shale	19	2
	72	0

No. 14.

Surface formation	19	0
Black shale	9	0
Coal	0	7
Grey coaly shale	9	11
Dark shale	5	0
‡Coal	2	7
‡Dark coaly shale	2	5
‡Coal	1	6
‡Dark shale	1	3
‡Coal	1	2
Dark coaly shale	5	1
Dark sandy shale	3	10
Dark coaly shale	1	8
Ironstone	0	4
Grey sandy shale	24	0
§Coal	1	4
§Sandy shale	0	3
§Coal	3	1
§Coaly shale	0	11
	93	0

No. 21.

Surface formation	25	0
Yellow sandstone	5	4
Coal	1	1
Brown coaly shale	1	1
Grey coaly shale	3	0
Grey shale	2	0
Dark coaly shale	1	3
‖Coal	2	1
‖Grey coaly shale	2	7
‖Coal	2	1
Dark shale	1	0
Grey shale	1	6
	48	0

No. 22.

Surface formation	19	0
Grey sandy shale	17	0
Yellow sandy shale	1	5
Grey sandy shale	8	11
Grey sandstone	3	8
Grey sandy shale	11	6
Dark-grey shale	3	11
Coal	1	1
Coaly shale	4	6
Grey sandy shale	14	0
Coal	0	9
Grey coaly shale	1	8
Grey shale	3	7
	110	0

* Bridge Seam. † Sandstone outcropping at bridge. ‡ Lapham Seam. § Burrum Seam. ‖ Watson's Seam.

QUEENSLAND COLLIERY COMPANY'S SHAFT.

	Ft.	in.
Surface formation	34	10
Fireclay	7	0
Black coaly shale (containing *Pecopteris*)	5	9
Sandy clay	4	10
Black shale	0	3
Coaly shale	8	4
Coal	2	1
Black clay	0	11
Light fireclay	5	6
Coaly shale	6	11
Coal	1	0
Fireclay	1	6
Dark coaly shale	5	0
Coal	0	9
Fireclay	1	3
Dark shale	3	0
Sandy fireclay	13	8
Striped sandstone	11	8
Ironstone	0	3
Coaly shale	9	0
Fireclay	2	1
Coaly shale	3	3
Coal	0	6
Coaly shale	3	6
Coal	0	3
Black shale	1	3
Fireclay	3	4
Shale	4	5
Coal	0	7
Dark shale	0	4
Coal	0	4
Black shale	0	6
Coal	0	3
Fireclay	2	8
Sandstone (with ironstone bands)	7	8
Light clay	1	11
Coal	0	9
Black shale	0	6
Hard sandy fireclay	4	7
Shale and ironstone	4	2
Shale (containing fossil ferns)	1	8
Sandy clay	3	0
Coal	0	3
Fireclay and bands of ironstone	6	10
Dark coaly shale and ironstone	5	1
Black shale	2	9
Coal	0	3
Fireclay	6	11
Striped sandstone and ironstone	4	5
Striped sandy shale and ironstone	7	2
Shale	3	4
*Coal	0	6
*Shale	1	1
*Coal	1	1
*Shale	1	6
*Coal	0	11
Fireclay	3	6
Coaly shale	1	0
Shales	11	7
Coal	0	9
Fireclay	1	3
Fireclay with nodules	2	6
	234	8

* Company's Seam.

APPENDIX B.

ANALYSES OF COALS FROM THE BURRUM COAL FIELD.

Name of Seam.	Water.	Volatile Hydro-carbons.	Fixed Carbon.	Ash.	Sulphur.	Specific Gravity.	Coke.
I. Whitley's Shaft (Queensland Collieries Company's Seam)	...	26·6	68·4	5·0	...	...	...
II. Beaufort Seam (Beaufort Shaft)	...	31·5	64·0	4·5	...	...	...
III. Burrum Seam	...	29·8	62·2	8·0	...	...	...
IV. Queensland Collieries Company's Seam ...	2·54	30·35	64·30	2·50 (grey)	0·35	1·24	66·80
V. Lapham or Torbanlea Seam (Torbanlea Colliery, bottom coal)	2·00	28·00	61·60	8·00 (grey)	0·40	1·31	69·60
VI. Ditto (top coal)	2·25	29·15	66·50	2·10 (grey)	...	1·26	68·60
VII. Burrum Seam (Torbanlea Colliery) ...	2·75	28·00	65·55	3·25 (reddish)	0·45	1·27	68·60

NOTE.—Analyses I., II., and III., are taken from Mr. A. C. Gregory's Report on the Burrum Coal Mines, 1879.
Analyses IV., V., VI., and VII., are by myself.

Mr. Henderson, C.E., manager of the Maryborough Gasworks, kindly gave me the following returns from twenty months' actual work with the coal from the Lapham or Torbanlea Seam :—

Gas	10,200 cubic feet per ton of coal,	candle power 14·73	
Coke	1,460 lbs.	,,	,, or 65 per cent.
Tar	10·5 gallons	,,	,,
Ammoniacal liquor ...	16·0 ,,	,,	,,

This seam has proved, in practice, to be superior to either the Queensland Collieries Company's Seam or the Burrum Seam for gas-making purposes.

The analyses of the coals from the Burrum would show that, with reference to the volatile hydrocarbons, of which, of course, a high percentage is necessary for gas-making purposes, they are not quite as good as the Newcastle coals (New South Wales). Fourteen samples of the latter averaged 37·55 per cent. of volatile hydrocarbons, including water; while the average of seven samples from the Burrum is 31·5, that is also taking the hydrocarbons and water together.

The ash, which represents so much of worse than useless matter, is by no means high: the highest result being 8 per cent. and the lowest 2·1 per cent.; the average being 4·6 per cent., as against an average of 4·97 per cent. in the Newcastle coal (New South Wales). It should be mentioned that the Burrum samples are from shallow depths, where the ash is generally higher. The ash is of a very light red or grey colour.

The sulphur, averaging 0·4 per cent. in the three samples in which I determined it, is very low indeed, and the coal will compare favourably in that respect with coal from any part of the world. Unfortunately, however, in all the analyses of the Burrum coals hitherto made, the sulphur has not been determined. The percentage of this constituent is most important in coals used for gas-making. Freedom from sulphur, too, is a great advantage in many metallurgical processes.

The average specific gravity of four samples was 1·27.

The cokes from the Queensland Collieries Company's Seam, the Lapham or Torbanlea Seam, and the Burrum Seam, are all good, coherent, dense cokes; that from the first-named being the densest.

The Burrum coal is not so good a steam-coal on account of its tenderness, it being very easily broken up by attrition, as I have before stated. However, I am of opinion that there will be a great improvement in it, in this respect, at greater depths.

GEOLOGICAL MAP Nº 1
ENVIRONS
OF THE
TOWN OF HOWARD

BY
WILLIAM H. RANDS
Govt Geologist
1886
with additions by
LIONEL C. BALL
Assistant Govt Geologist
1901

Scale 20 Chains to an Inch
20 15 10 5 0 20 40 60

Drawn by H.W.Fox at the Geological Survey Office, Brisbane 1902

SIGNS

- Outcrop of Seams of Coal
- Dip of Strata, the figures indicating the amount of inclining in degrees
- Boreholes
- Shafts
- Faults, triangle shews downthrow side

RESERVE FOR PUBLIC PURPOSES

RESERVE FOR PUBLIC PURPOSES

RESERVE FOR TOWNSHIP PURPOSES

RESERVE FOR CAMPING & WATER

RES.

BURRUM RIVER

PARISH OF BURRUM

PARISH OF WALSH

Q.C.C.Co L.TD

BURRUM COLLIERY

CLYDE COLLIERY

DUDLEY No 3 Sh. COLLIERY

RIVERBANK COLLIERY

TORBANLEA COLLIERY

HOWARD

Maria Creek

MARYBOROUGH AND BURRUM RAILWAY

MARYBOROUGH AND BUNDABERG ROAD

LINE OF SECTION A B

Index to boundaries of underground workings.
- Watson's Seam
- Torbanlea Seam
- Burrum Seam
- Jewel Seam

Section on Line A B shewing the Seams of Coal with their actual dip lying between the Bridge Seam and the Glenesk Seam
Scale Vertical and Horizontal 5 Chains to an Inch

By Authority: GEORGE ARTHUR VAUGHAN, Government Printer, William street, Brisbane.

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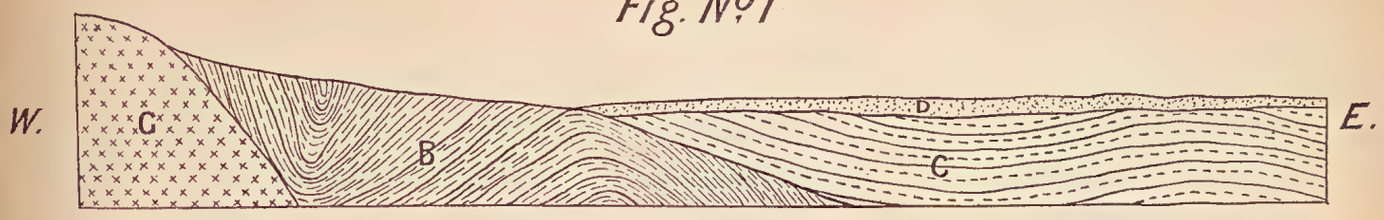
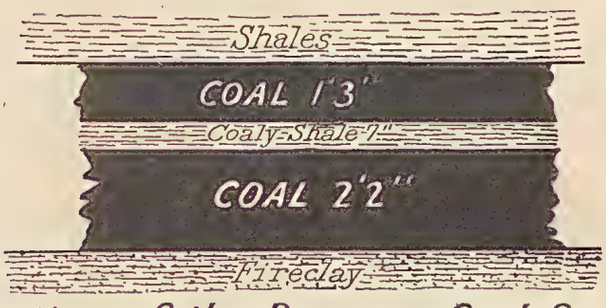
Fig. No. 1



Sketch Section across the Burrum Coal Field

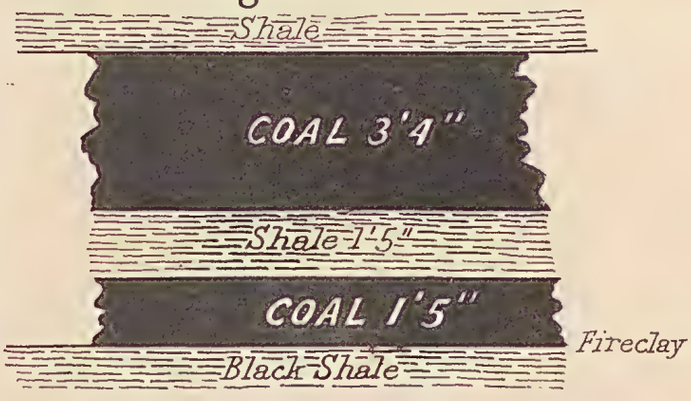
G Granite B Metamorphic Micaceous Schists &c.
C Coal Measures D Overlying Sandstones

Fig. No. 3



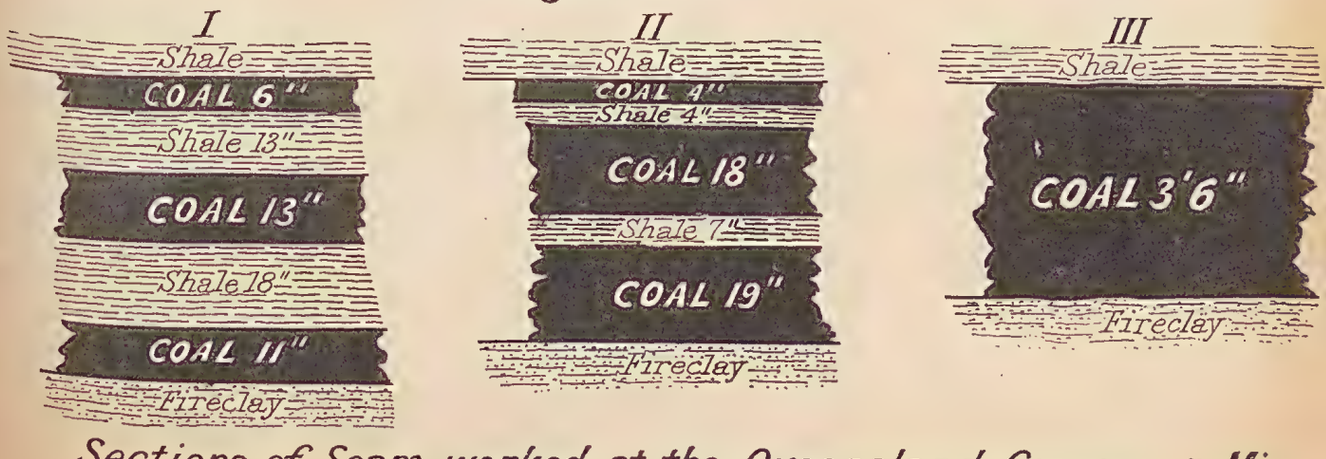
Section of the Burrum Coal Seam

Fig. No. 4



Section of the Lapham or Torbanlea Seam

Fig. No. 5



Sections of Seam worked at the Queensland Company's Mine

I Sec. at pit bottom. II Sec. in North West Level 430 ft from pit bottom.
III Sec. in North West Level 750 ft from pit bottom.

To accompany Report on the Burrum Coal Field by William H. Rands, Government Geologist.

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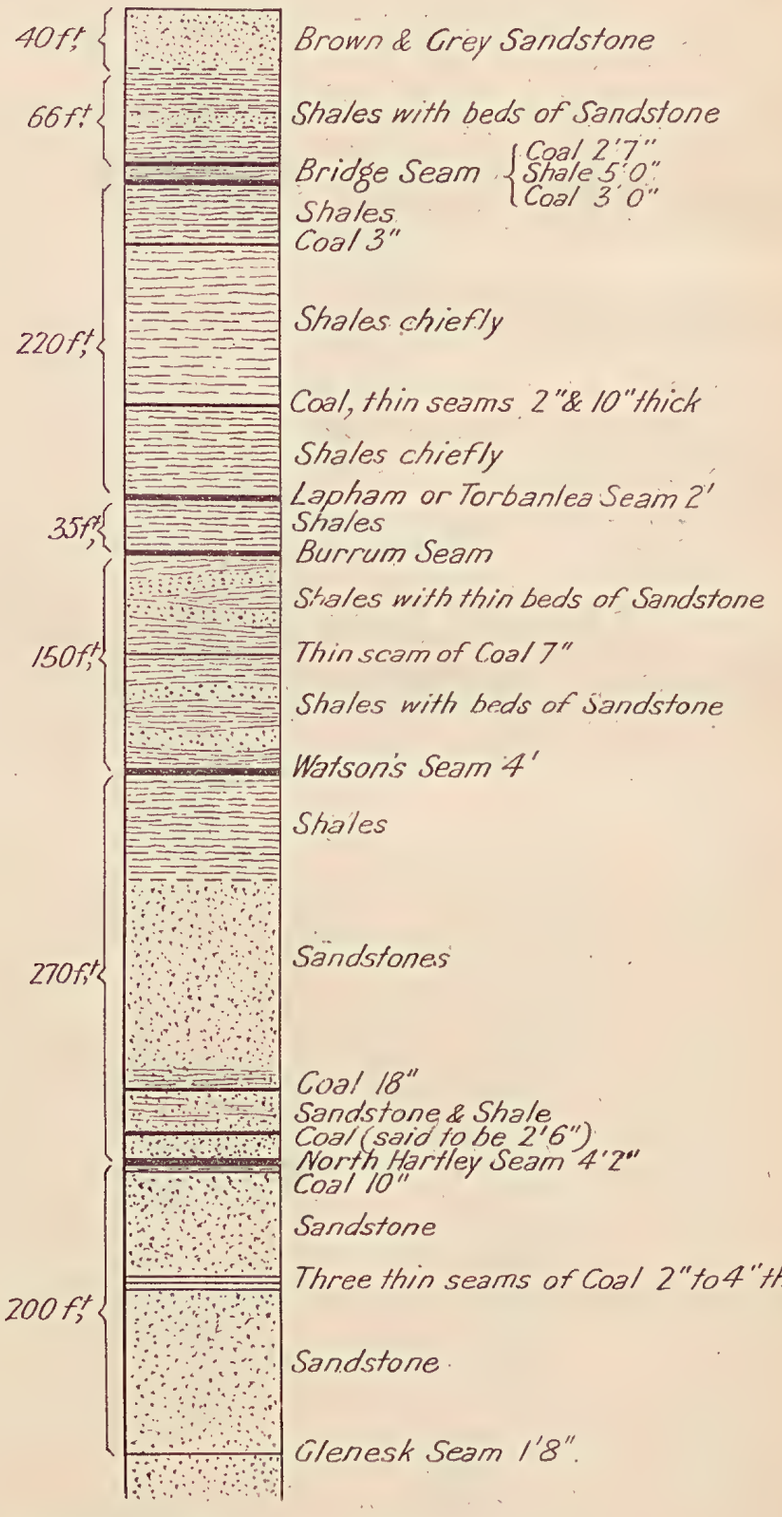
Fig. No 2



Vertical Section of Strata

Shewing the Seams of Coal between the Railway Bridge and the Glenesk Seam at the crossing place of the Bundaberg Road, Burrum River.

To accompany Report on the Burrum Coal Field by William H. Rands, Government Geologist.

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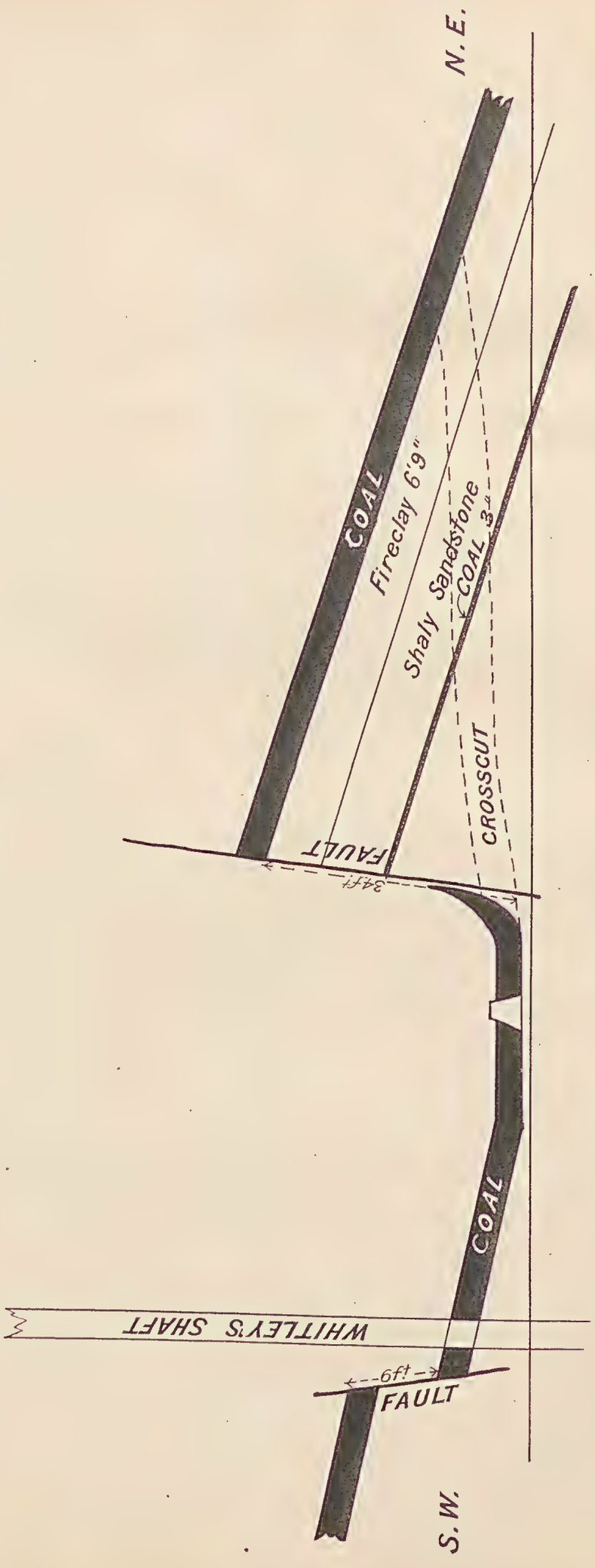
Fig. No 6

Section across Whitley's Mine in a N.E. direction shewing faults



To accompany Report on the Burrum Coal Field by William H. Rands, Government Geologist.

NATL
VICTORIA

REPORT BY LIONEL C. BALL.

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I.—INTRODUCTION.

Following my instructions from the Government Geologist, I visited and inspected the mines now working on the Burrum Coal Field. I also saw a few outcrops of coal exposed since Mr. Rands' visit in 1887, and obtained information with regard to bores put down and mines worked up to the present time. The scope of my work was thus limited, as the field had already been completely traversed and reported on by Mr. Rands.*

My survey was the outcome of a request for a report on the field, that one or more bores might be put down to discover what coal measures exist below the present workings, and whether the coal improves in quality and quantity to the dip. Numerous bores have been sunk by private enterprise, but, with a few exceptions, none have reached a greater depth than 200 feet, and thus they have only sufficed to test the strata near their outcrops.

II.—COLLIERIES IN OPERATION.

The Burrum and Riverbank are the only collieries now working, but it seems likely that operations will shortly be begun at Colton.

Burrum Colliery.—This is the property of, and is worked by, the Queensland Colliery Company, Limited, Howard. It was being worked at the time of Mr. Rands' visit, but the monthly output has increased from 1,500 tons at that time to 8,200 tons (August, 1901), and the area covered by the workings from less than 40 acres to over 300 acres.

The property includes portions 5, 23, 24, 26, and 27, Burrum, and has a total area of 1,781 acres, under about 1,300 acres of which the Torbanlea Seam may yet be worked.

The main seam worked is supposed to be the Torbanlea (the Lapham), the Burrum being about 33 feet below, but, as cut in the bore in No. 8 Pit, too stony to be exploited. The Jewel Seam (found between the Burrum and Watson's Seams in Torbanlea Colliery) was cut by the same bore, but was too thin to work. None of the bores to the "rise" of the workings, though proving strata for a depth of 330 feet below No. 8 Pit, cut a payable seam. Watson's Seam should have been found, and probably will be, under other portions of the property. A little work was done on the seam cut in No. 5 Shaft, about 50 feet from the surface.

In the accompanying map (No. 1), it will be seen that there are fourteen shafts. Nos. 5 and 8 and A Pits are the only ones now used for hoisting. No. 5, the main shaft, is 275 feet deep; No. 8 is 196 feet; and A Pit is 183 feet deep.

The workings extend about 12 chains to the west from No. 1 Shaft, beyond which, the coal being within 50 feet of the surface formation, was too soft and bleached to be worth extracting.

The coal was not worked on the east and north-east of the shaft—*i.e.*, to the "dip," because of shale bands in it increasing rapidly in those directions. A drive was put in to the south but abandoned, there being two clay bands in the coal. It is also reported that there was a fault running about east by south and west by north at the southern extremity of the workings, but the plans give no definite information on this point.

These workings having been completely abandoned, I was unable to inspect them.

From No. 5 Pit the worked ground extends to the dip for a distance of 22 chains, and work is still being carried forward. The coal has been exhausted to the rise of the shaft, with the exception of a small tongue on the west. At the bottom of the shaft, there is 6 feet of clean coal with no bands, and the dip is about 1 in 6 to the north-east. The thickness varies from 5 to 7 feet for a couple of chains to the dip, but thin lenticular bands of shale appear in it here and there.

Beyond that one of the bands near the roof increases gradually to a foot in thickness, at a distance of 7 or 8 chains from the shaft, almost cutting out the top coal, the bottom coal being there 3 feet 6 inches thick. About 15 chains to the dip the band is 18 inches thick, the top coal (with bands) 3 feet, and the bottom 6 inches. The band continues down to the sump where it is 22 inches thick; the top coal is 12 inches, and the bottom 3 feet thick. On the left of the "dip" (the mainway to the dip), near the bottom level, there is 4 feet of coal dipping about 1 in 6 to the north-east, though a little higher it is

* Report on the Burrum Coal Field, by William H. Rands, Assistant Government Geologist, Brisbane. By Authority: 1886.

quite flat. On the right of the "dip" the coal is 3 feet 6 inches thick, and is somewhat flatter. In the Longwall Workings on the north-west of the main "dip," the coal is only 2 feet 6 inches to 3 feet thick; over it is 2 feet 6 inches of shale, which is blasted down for gob-filling, and 18 inches of top coal, which is left for roof. The inclination of the seam here is very great—up to 1 in 3 in places.

Evidently the coal is cutting out to the dip while the band increases. There is, however, no reason to suppose that the band will thicken indefinitely, but rather it may be expected to thin out again. The mean dip may be taken as 1 in 10, and the direction as roughly north-east, but the seam rolls to a great extent, and the dip sometimes swings round from east to north.

The thickest coal is worked from No. 8 Shaft, and the worst roof in the colliery is found in the same neighbourhood. The area of ground opened here is not great. North-east of the shaft the coal is 6 feet 6 inches thick, with no bands, but the seam is also found only 4 feet thick at no great distance away. Slickensides are very frequent in the roof to the north-west of the shaft, and necessitate so much timber that it is sometimes difficult to remove the coal. The inclination of the seam in this portion of the mine is comparatively gentle.

A seam of clean coal, 2 feet 6 inches thick, 8 feet below the main seam has been reached by a stone drive a couple of chains in length, leaving the main level 1½ chains north of No. 8 Shaft. The drive was continued as a "heading" on the seam, for a chain, and two levels have been commenced on the north-west. The coal is good, as usual here when the seams are thin.

The same seam was worked over an area of about 160 acres on the north-west of No. 1 Pit, and 50 acres around and to the south of No. 4 Pit.

The A Pit was opened less than two years ago. A main level was driven from the shaft 10 chains to the north-west, and from it "headings" and "dips" have been begun. The coal to the rise is 5 or 6 feet thick in places, and the inclination is 1 in 6½ to the east-north-east. At the shaft bottom the top coal is only 4 feet thick, and is not free from thin shale bands; 18 inches below it is another 4-feet seam of coal. The top coal is cutting out at a distance of 7 chains from the shaft to the dip, the band being 2 feet thick; but the bottom coal is still 4 feet thick, including a couple of 2-inch bands. The dip is to the east-north-east. There is an east and west fault about 3 chains north of the shaft, with an up-throw of about 6 feet on the south, so the main level from the foot of the shaft was carried on as a stone drive till it struck the coal again. In the most northerly face the bottom coal is 3 feet thick without bands, and above it is 3 feet 6 inches to 4 feet of band, which is blasted down for gob, the 6 inches of top coal being left for a roof. The coal has a very slight dip to the east-north-east. To the rise of this, however, the coal increases within 60 yards to 5 or 6 feet in thickness, but beyond that again in the face there is 4 feet of top coal with a persistent 2-inch band 6 inches from the bottom, then an 18-inch band resting on 4 inches of coal. Above the top coal is 6 inches to a foot of coaly shale, and above that 12 inches of coal (left for roof). The dip of this portion, *i.e.*, above the main level, is from 1 in 6 to 1 in 3¾ to the north-east by east.

The workings then in this colliery are being pushed out to the north-west, north, and north-east, the great body of coal being on the north and north-east. A comparison of the dips and depths of the shafts shows that the strike of the seam is swinging round towards the north as the workings are carried to the north-west. This, however, is perhaps only a local variation. For results of analyses of Queensland Collieries Company's coal see Appendix I.

Gas has not yet been reported from this mine.

In exploitation here a main level is run out along the strike, and from it "dips" are driven directly to the dip and "headings" to the rise. Other levels are opened from these at convenient distances of 1 to 5 chains apart, and from these last bords 15 feet wide and 12 to 15 yards apart are carried to the rise.

Six-inch props spaced about 2 feet apart with squared caps, 8 by 3 inches in section, are used in most of the mainways. In some of the levels the props are actually in contact for long distances owing to the pressure which sometimes necessitates renewal after only six months standing. There are in the longwall faces two rows (3 feet apart and 18 inches from both face and gob) of 4-inch props (spaced 6 feet apart) with corbels about 4 feet in length and 4 by 3 inches in section.

The timber (ironbark preferably but not exclusively) has to be carted by the contractors nine miles to the mine. This, together with the fact that little is drawn from the old workings, brings the price of timber used, per ton of coal extracted, up to 7d.

Riverbank Colliery.—This colliery is situated in Walsh's Ground (portion 1, Walsh) less than a quarter of a mile south-south-west of the railway line, and east of the Burrum River. It is worked by Mr. James Robertson of Maryborough, who has leased the property from the Bank of Australasia. Mr. Robertson has held the lease since the Isis Land and Investment Company went into liquidation, a few months after purchasing the property from Messrs. Wright and Black in May, 1899.

The coal seam worked is the Burrum. The Torbanlea Seam was cut 35 feet above, but it was in the form of two thin seams quite unworkable.

Particulars of the workings will be found on the accompanying plan (No. 1). The main shaft is 220 feet deep, on 3 feet 6 inches (the average thickness) of clean coal. A shale band appears a couple of chains to the dip and increases continuously in thickness, till in the sump, 7 chains from the shaft, it is 22 inches thick. The average dip is about 1 in 4½. In the bottom level, 22 yards above the sump, the band is only 12 inches thick, and both top and bottom coals are 18 inches in thickness. In the northern face of this level the coal is 4 feet 6 inches thick with a 3-inch band in the middle. The dip there is 1 in 5 to the north-east. At the south end the band is 6 inches thick (variable), with 18 inches of coal above and below. Bands come in along the strike on both sides of the shaft, and one on the extreme north is 2, 3, and 4 feet thick in different places, while there is 20 inches of coal on top and 15 inches below, which could only be worked at a loss. To the dip of this level, however, the band is only 3 inches to 6 inches thick in the centre of 3 feet to 4 feet 6 inches of coal. This band which gives so much trouble, appears at first as an impure coal which passes into coaly shale and that into pure shale in the thickest parts. Where this band occurs the coal above it often contains much nodular clay ironstone—the nodules sometimes being 2 feet or more in length. The carbonate (and sulphide) of iron appears to have replaced the coal. The bottom coal never contains nodules.

Gas can be heard blowing off strongly from the coal in one of the unused faces on the north-west, but the ventilating air current is quite strong enough to clear it off at once without danger.

Numerous borings have proved that there is a seam of impure coal slightly under 3 feet thick containing a band 2 inches to 10 inches thick, about 3 feet to 6 feet above the main seam. It has been reached by a stone drive from the main level near the shaft, and is there 3 feet thick with a band varying from 6 to 10 inches in thickness, 9 inches from the top.

Owing to the increasing thickness of the band and the thinning out of the coal it is feared that operations cannot be carried on for any length of time at this colliery unless bores to the north-east prove the seam to improve in that direction.

The output of the Riverbank is 30,000 tons per annum, of which 2,000 tons per month are just now going to Mount Morgan.

Most of the coal is obtained by the "double bord from the dip" system—a face 10 yards wide being carried to the rise, while gob is built up behind, in the middle, forming an airway on each side.

All coal has to be blasted down and hand-drills are used for boring the holes. These are of two kinds. A simple bit 30 inches in length attached to a long screw, turned, in a bracket let into the wall, by a handle at the end. This is capable of boring a 3-inch hole to a depth of 3 feet in ten minutes, but will only work in coal. When stone is likely to be met a special drill worked from a prop, like a jack, with a clutch, is employed. This is very much slower, but proportionately stronger.

On account of the great inclination of the headings balances have to be used in most of them to assist in transporting the loaded trucks to the levels. The balance consists of a small loaded truck running on a side line and connected round a pulley with the coal truck.

Timber of the same size as in the Burrum Mine is used, but much less in proportion is necessary.

The cost of raising the coal is 7s. 6d. per ton, but at the Burrum Colliery it is less, as the coal does not need to be blasted, and the seam is thicker as a rule. The cost when working the thick band in the coal is 25 per cent. greater.

Rope haulage from the bottom to the main level is used in both the Riverbank and Burrum Collieries, the engines being stationed at the surface. The coal trucks are run from the cages on to timber hoppers, which are about 50 yards in length, 20 feet wide and 10 feet, and under which the railway trucks pass to be filled. The coal can also be tipped directly into the truck. A ventilating fan is employed in the Riverbank and also at the Queensland Collieries Company's Colliery.

III.—ABANDONED MINES.

These are six in number; the most important, the Torbanlea, may be reopened in the future, and the Dudley and the Clyde may also, but the others appear to have been entirely given up.

Torbanlea Colliery.—This is on portions 19, 12, and 34, Walsh, the main shaft being about three-quarters of a mile south-south-west of the Torbanlea Railway Station. Portion 19 was taken up by Mr. Robertson in 1883, and sold to the Isis Investment Company five years later. The colliery was worked under Mr. Robertson's supervision till the company went into liquidation in the beginning of 1900. The property then passed again to its former owner, who is also part owner of portion 34, and lessee of 140 acres of portion 12. Work ceased a few months after the transfer.

The colliery being flooded, I was not able to make an inspection; but Messrs. Robertson and Sharp, the owner and manager, have placed the plans at my disposal, and have given me the following particulars:—

Four different seams have been worked in the colliery—(*a*) the Torbanlea, (*b*) the Burrum, (*c*) the New or Jewel, and (*d*) Watson's.

The strike and dip in all the workings seem to have been fairly constant, the dip being 1 in 3½ to 4 in a direction 60 degrees east of north.

The workings on the Torbanlea Seam were the most extensive, covering about 80 acres. The main working shaft (No. 2) is about 390 feet deep—to the Torbanlea Seam, which was cut in No. 2 Air Shaft at 60 feet depth. The main level has a total length of 80 chains. The worked ground extends about 14 chains to the rise. No work beyond a prospecting drive 7 chains in length has been done to the dip of No. 2 Shaft. Even at the pit bottom the seam was scarcely workable, there being 1 foot 6 inches top coal and 1 foot 4 inches bottom coal separated by 7 feet of shale, which, however, decreased to 3 feet within 15 yards to the rise. Rapid increase in the size of the band to the south-east as well as east put a stop to work in that direction. About 30 chains north-west of the shaft is a north-north-east and south-south-west fault with a down-throw of 110 feet on the northern end, but only a few feet on the southern; the seam in this portion of the mine comprises 4 feet 6 inches top coal and 1 foot 6 inches bottom coal, separated by a 1 foot 8-inch band. Work would have been carried to the dip north of the fault, but the coal was found to be cut off by another fault running at right angles to the first. It was assumed to be the same fault as before struck, and therefore an up-throw on the north-east, though indications pointed to its being a down-throw. A vertical bore-hole was driven up, but failed to cut the seam, and funds were not forthcoming to prospect by sinking. On the north-west the coal thinned away till unworkable. The usual payable section elsewhere in the colliery was:—Top coal, 3 feet; band up to 2 feet; bottom coal, 12 to 14 inches.

Inflammable gas was sometimes met with near the faults, and a few slight explosions took place, one just before operations were suspended, causing the death of four men.

The workings on the other seams are off a "stone drive," driven to the north-west from near No. 2 Shaft with the usual gradient of 1 in 100 towards the shaft. The distances are—Torbanlea to Burrum Seam, 2½ chains (proving strata about 40 feet thick); Burrum to New or Jewel Seam, 3½ chains (proving an additional 113 feet); Jewel to Watson's Seam, 5 chains (proving a further 95 feet). The drive as continued along the Watson Seam was practically a stone drive with a total length of 22 chains.

In No. 1 Shaft the Burrum Seam was struck at a depth of 125 feet, and in No. 2 Air Shaft at 120 feet depth.

The Burrum Seam Workings cover about one-half the area of those of the Torbanlea Seam. The main level, which is 2 to 3 chains north-west of Torbanlea Seam main level, is 40 chains in length. The general section of the seam was:—Top coal, 1 foot 8 inches; band, 1 foot 6 inches; and bottom coal, 2 feet;

but a band developed to the dip in both top and bottom coal in the sump of No. 2 Shaft, and work was stopped in consequence. Borings and the isolated workings just east of the big fault proved the seam unpayable.

The workings on the Jewel Seam proved the coal, of which there were 2 feet 6 inches, to be dirty, especially the top 8 inches. The mainlevel was 15 chains in length. From 3 to 6 feet above this there was 2 feet of coal called the Stranger Seam.

In No. 3 Shaft the Watson's Seam was cut at 220 feet deep but proved unworkable there, being thinner even than in the bores, where its total thickness, including a band over 2 feet thick, a foot from the bottom, was 4 feet 7 inches.

The output of the Torbanlea Colliery in late years was 30,000 tons per annum, 150 men being employed.

Comparing the Torbanlea, Riverbank, and Burrum Workings, it is seen that the outcrops strike roughly north-west and south-east, but there appears to be a fault between the Burrum Colliery and the Burrum River, throwing the strata on the west a few chains to the north-east.

Dudley Colliery.—This colliery was opened in 1888, on the co-operative principle, by a number of local people. Little or no information can be obtained about it. It closed down after four years' work, competition having brought the selling price of coal to below the cost of production.

The ground worked was J. Joss's Portion 4, Burrum (see Map 1), and the first shaft was sunk 150 yards north-east of the railway line, about 50 chains from the Howard Platform. Mr. Christensen, of Howard, tells me that this shaft was sunk after No. 1 Bore, 17 chains to the rise, had struck the following seam, probably the Jewel, at 54 feet depth :—Top coal, 1 feet 11 inches; band, 1 foot; bottom coal, 3 feet 4 inches. In the shaft a seam of poor coal was passed through at 60 feet below the surface (the Torbanlea Seam, possibly), but below that to a depth of 200 feet only thin seams were cut. The sandstones from this shaft contain great numbers of leaves and stems of plants, and the ironstone much calcite (derived, perhaps, from Rocellaria and Phyllocarida, traces of which are to be seen in microscope sections).

From the bottom of the shaft a bore was put down and struck at 80 feet below 2 feet 6 inches of coal, probably Watson's Seam, though it is extraordinary that the intermediate seams were not cut. The shaft was then abandoned. A bore 4 chains to the north-west cut 5 feet of coal, the absence of which in the shaft was explained by assuming a fault.

No. 2 Shaft was then sunk at a point 120 yards across the railway line in a south-westerly direction, and passed through 45 feet of surface formation, 16 feet of sandstone and shale into a coal seam 11 feet 6 inches thick, made up of: Top coal, 1 foot 6 inches; band, 3 feet; middle coal, 1 foot 6 inches; band, 3 feet 6 inches; bottom coal, 2 feet. This was thought to be the Torbanlea Seam, but it is more probable that it is the Jewel.

To obviate the necessity of constructing a branch line to connect with the Government Railway this shaft was abandoned and a third sunk beside the railway line, between Nos. 1 and 2, to a depth of 180 feet. This would be approximately the depth of Watson's Seam.

It is reported that gas was fairly plentiful in the mine, and great care had to be taken before firing shots.

No. 3 Bore was 20 chains to the rise of No. 1 Shaft, and cut 3 feet of coal (Watson's Seam) at 53 feet 6 inches from the surface.

Clyde Colliery.—Steeley's Portion 21, Burrum, which adjoins the railway line opposite the Howard Station, was leased for mining by the Queensland Collieries Company four or five years ago, when there was an extra strong demand for coal.

The seam worked, apparently the Torbanlea, was called the Beaufort. It was reached by a couple of inclined tunnels, 6 and 10 chains in length respectively, driven about a quarter of a mile east of the Howard Railway Gates. The workings extended for 19 chains along the strike, but only for 3 chains to the dip from the softened out-cropping portion. The two following sections are taken from the mine plans:—On the outcrop: Top coal, 4 inches; band, 3 inches; coal, 4 inches; band, 9 inches; bottom coal, 12 inches. On the north: Top coal, 4 to 8 inches; band, 2 to 4 feet; bottom coal, 6 to 12 inches. Such could scarcely be considered payable.

A shaft near the outcrop proved a 3-feet seam of coal at a depth of 150 feet; this may be the Watson's Seam. The reddish ferruginous and carbonaceous shale from this shaft is full of plant remains, chiefly stems.

Shafts and adits have collapsed, so the workings are inaccessible.

New Briton Shaft.—This is situated on the south side of Maria Creek, half-a-mile below the railway line. No information obtainable.

East Burrum Shaft.—The shaft is half-a-mile north-east of the Burrum Platform. It was sunk a couple of years ago by local miners to a depth of 60 feet, when coal was struck, but water rose so quickly that work had to be discontinued till pumping machinery could be installed. No further steps have yet been taken. This was thought to be the Bridge Seam, but that should be at least 250 feet deep here.

Glenesk Colliery.—No work has been done at the Glenesk Mine since the time of Mr. Rands' visit.

The outputs of the Burrum Mines are given in Appendix 7.

IV.—PROSPECTING.

With regard to prospecting, most has certainly been done on the Torbanlea Properties. In the first place, the Torbanlea Seam was traced south-eastwards by means of a series of boreholes mentioned in Mr. Rands' Report, and some thirty holes have since been sunk in the neighbourhood of the colliery, almost all being to the rise of the deepest level. A total thickness of about 1,100 feet of strata was proved.

The total length of "stone" drives shown on the Torbanlea plans is 726 yards, and the south-western portion of the main level on the Torbanlea Seam was only carried on for prospecting purposes. The dip from the main level at No. 2 Shaft was opened for 7 chains simply to prospect the seam, with the hope that it would improve to the dip. Prospecting work only was done on the Jewel and Watson's Seams.

Records of fifteen bores on the Queensland Collieries Company's property have been obtained. The plan shows that the coal has been worked from about A, B, D, E, J, K, and No. 6 Bores, and of the remainder C, F, G, H, and I are especially valuable, showing a total thickness of about 400 feet of strata below the surface of A, the total from the top of J to the bottom of I being about 550 feet. It will be noticed that no payable seams were found in the Government Reserve by these bores, the large ones all reaching the surface to the north-east.

There is one prospecting drive carried for a chain to the dip of No. 1 Shaft, and another was carried the same distance beyond the payable portion of the seam on the south. The stone drive from the top to the bottom seam in No. 8 Pit has been already referred to, and is about 2 chains in length.

Though the manager of this colliery feels no great anxiety, it is evident that the band is increasing to the dip, as it has in the Torbanlea and Riverbank Mines.

In the Riverbank Colliery much prospecting has not been done, though some levels have been carried beyond the point at which the coal extracted paid for expenses, and, as mentioned, bores and a stone drive have tested the seam above the Burrum.

Prospecting on the surface has not been carried out to any great extent. This is perhaps due to the fact that outcrops of the coal measures are only to be seen in the creek beds, and the coal being the most friable rock is eroded quickest, with the consequence that the outcrops occur chiefly in the bottom of the deepest waterholes. My visit was unfortunately just after rain, so that less even than usual could then be seen.

V.—FRESH OUTCROPS.

At the Maryborough-Bundaberg Crossing, on the right bank of the Burrum River, a seam of coal has been exposed. It consists of 6 inches top coal, 12 inches fireclay, and 12 inches bottom coal resting on fireclay. It is covered by thin bedded sandstones, and dips 15 degrees to the north 30 degrees east.

On the opposite bank is a 10-inch seam upon coaly shale and covered by grey sandstone, dipping 29 degrees to the north 50 degrees east. There must be 50 feet of strata between these two seams. They lie on the line of strike of the Glenesk Beds.

A seam of coal which varies from 6 to 12 inches in thickness and dips 10 degrees to the north-east is to be seen about a quarter of a mile below the old Bundaberg Crossing, on Cherwell Creek, or about a mile below the railway bridge. This is about on the line of outcrop of the Torbanelea Beds.

The railway crosses Cherwell Creek just on the summit of a flat anticlinal fold. As the dip of the strata varies so much it is not yet possible to correlate the Burrum and Cherwell Seams.

In a billabong on the south bank of the Gregory, in the centre of Leson's Portion 76v, Isis, which is midway between Goodwood Plantation and Railway Platform, is a seam of good coal, said to be 21 inches thick, of which only 15 inches are out of water. It rests on, and is covered by, grey shale in which is a thin band of coal 15 inches above the main coal. The dip is from 1 in 5 to 1 in 6 to the south-west.

The promising outcrop induced a Bundaberg Company to put down a series of bores here (of which particulars will be found in Appendix 3). The outcropping seam may be the Torbanlea (thinned out), as seams were cut in No. 1 Bore in the relative position of the Burrum, Jewel, and Watson's—all thinner than on the Burrum. The thin seams seem also to have diminished in number.

A few hundred yards south of Goodwood House, in a washaway of the river, is a seam of coal 4 inches thick, dipping 10 degrees to the east and east by south. It is overlaid by sandstone, and underlaid by shales and clay ironstone beds.

In a creek a quarter of a mile below Goodwood House, across the river, and 50 yards above it, is a 1-foot seam of coal, which seems to be almost horizontal but may have a slight dip to the south. It is said to be also visible in the river bed, 50 yards above the creek's entrance, in times of drought.

The dip of the strata south-east of Goodwood House varies much; in one place the ironstone, sandstones, and shales dip 1 in 3 to the west, in another, a little further north-west, they dip 1 in 5 to the south-west.

A 2-feet seam of coal, now under water, has been seen by Mr. H. Smith, of Howard, about three miles up the Isis River from its junction with the Burrum. This is roughly in the line of outcrop of the productive seams on the northern portion of the Burrum (Howard) Colliery.

VI.—BORINGS.

The most northerly are the Goodwood Bores, then come the Howard, the Riverbank, the Torbanlea, the Colton, and the most southerly—the Saltwater Bores.

The borings thus extend along the outcrops for 28 miles (*i.e.*, from portion 76v, Isis, to 223, Maryborough).

The first line of bores put down by Mr. Robertson between the Burrum River and Torbanlea are the farthest to the dip, and therefore pass through the highest beds of any. The northern line of bores at Colton is farthest to the rise, and hence proves strata below all the others.

The total thickness of strata, perpendicular to the beds, passed through from the top of No. 9 Bore, Burrum, to the bottom of No. 3 North Bore, Colton, is over 1,700 feet, but there are two gaps (amounting to 250 feet) below the bottom of the southern line at Colton, and one (of 50 feet) above the top of No. 5 Bore, Torbanlea.

The bores have been plotted on the maps and the strata have been found to coincide fairly well in the different bores. The bores have also been arranged (see Plate 1) so that the relation of the strata in any one can be found to the strata in the others.

Goodwood Bores (*see Map* 2, *Plate* 1, *and Appendix* 2).—Three bores have been put down. The first to a depth of 345 feet, cutting thin seams, which may be the Torbanlea, Burrum, Jewel, and Watson's. It is considered that it will be possible to carry this bore to a greater depth if necessary. A second bore, 300 yards to the south, only just entered the shale under the surface formation when it was left, and work was begun on a third about a quarter of a mile south of No. 1 Bore.

Howard Bores (*see Map* 1, *Plate* 1, *and Appendix* 3).—These are sixteen in number, arranged in lines; one along the outcrop of the Torbanlea Seam and three across it.

Besides the Burrum Seam (about 30 feet below the Torbanlea), which was stony, the Jewel and Watson's have been cut, but too thin to work.

The outcrops have been plotted from the bores.

Burrum Bores (*see Map* 1, *Plate* 1, *and Appendix* 4).—A couple of bores on the bank of the Burrum, between the outcrops of the Torbanlea and Burrum Seams, are given, and one west of the present Riverbank Colliery showing the Watson's Seam.

Torbanlea Bores (*see Map* 1, *Plate* 1, *and Appendix* 4).—The two first lines of bores proved a thickness of 500 feet of strata above the Torbanlea Seam, and 120 feet below it, *i.e.*, down to the Jewel Seam. The bores and No. 2 Shaft proved thin banded seams, about 50 and 130 feet above the Torbanlea, and a number of seams from 4 inches up to 4 feet 8 inches (with bands) about 250 feet above it. The Jewel and Watson's Seams were found below the Burrum.

Colton Bores (*see Plates* 1 *and* 2, *and Appendix* 5).—The Maryborough-Burrum Colliery Company was formed in 1887, and took up an area of 1,700 acres on the railway line, a couple of miles north of Colton Station. During the year twenty-seven hand bores and two diamond-drill bores were put down. Mr. H. A. Jones, of Maryborough, has procured me the published engineer's report, and, in addition, tracings of the plans, of which part (*Map* 3) is given elsewhere. These bores cut besides many other seams:—

3	feet	8-inch	seam,	at	67	feet	depth;	4	feet	11	inches,	at	131	feet
3	,,	2	,,	,,	172	,,	,,	4	,,	5	,,	,,	153	,,
2	,,	6	,,	,,	106	,,	,,	3	,,	0	,,	,,	117	,,
3	,,	9	,,	,,	106	,,	,,	3	,,	1	,,	,,	99	,,
3	,,	5	,,	,,	50	,,	,,							

It is strange that no further work has been done here. There is scarcely any necessity for further boring till these seams have been sunk on.

It is proposed with the funds now at hand to sink 200 or 300 feet. The best position for a shaft would be as far to the dip as possible, if the company could incur the expense of sinking 1,000 feet. As they will not sink more than 300 or 400 feet, the shaft might be opened on the site of No. 14 Bore of the northern line to strike the 4-feet 11-inch seam, or that below it, at a depth of about 300 feet, or it might be situated 5 chains further to the dip, to strike the same at a depth of 400 feet. It would be advisable to first put a trial shaft down on about the site of No. 9 Bore.

An attempt has been made to find the relation that the seams struck in the different bores have to one another, but this is little more than guesswork, with only the data given in the engineer's report —viz., thickness of seams and depth from the surface. However, assuming that the dip of the strata decreases towards the north-north-east, and that the strike is east-south-east and west-north-west, the bores plot out fairly well. The beds passed through by No. 11 Bore on the northern line should be found in No. 11 on the southern, but it was thought the bed of sandstone in the former was not cut till No. 18 on the latter. This might be so if the strike is here nearer east and west than usual, or if there is a fault between the two lines of bores.

It is possible that the seams cut are the Torbanlea, Burrum, Jewel, Watson, and Glenesk, in which case these bores and the series at Torbanlea give a total thickness of over 1,700 feet of strata.

Saltwater Bores (*see Plates* 1 *and* 3, *and Appendix* 6).—Of the sixteen bores at Saltwater, four give no information, having only just entered coal measures, and five others show almost the same strata, as the line of bores does not make a large enough angle with the strike of the beds. It is very probable that the seams cut are the Burrum, Jewel, and Watson.

VII.—REQUIRED BORES.

It really would appear at first sight that coal seams are splitting up towards the dip into innumerable leaves in the shales. There is, however, a great probability that the shale bands will cut out again, for though on the edges of the Torbanlea, Riverbank, and Burrum (Howard) Workings, the seams have, from the same cause, proved unworkable both along the strike and towards the dip, yet they have proved workable again at a distance along the outcrop (*i.e.*, in the other collieries). The distance between the Torbanlea and Riverbank Workings is one mile, and between the Riverbank and the Burrum (Howard) Workings is two miles, all of which may not be unpayable. I should therefore suggest that a series of deep bores be put down at least as deep as the Torbanlea Seam, three bores in line to the north-east half-a-mile apart, and from the workings of both the Torbanlea and Burrum Collieries. The first bore would be roughly 500 feet deep, the second 700 feet, and the third 1,000 feet.

If only one bore be proposed on each side the river, the sites selected might be the north-east corner of portion 23, Burrum, for the west, and a point along the railway line on the south-east of Torbanlea Station for the east.

Proved thick seams would encourage greatly increased work, not alone on the collieries at present working, but in other portions, and besides would enhance the value of the land in the district, much of which on the reserves and unalienated portions is fit for nothing but mining.

Boring at Aldershot (Saltwater Creek) proves the presence there of seams which are almost of workable thickness, and may increase to the dip, but would require boring to prove them.

The country on the Gregory shows outcropping coal, and to prove the lower seams it may be necessary to bore into the anticlinal fold at the railway bridge.

Concerning the request that bores be put down to prove seams below the present workings, it may be noticed that it is already known that there are the Jewel, Watson's, Hartley, and Glenesk Seams, each proved workable, at least, in places, by certain bores. The only work done on these was at Torbanlea, where, however, they proved unpayable. The necessity now is to test the seams in other parts by shafts.

Regarding boring machinery, hand jumping drills are always used on the field because of small first cost, portability, and general cheapness. The diamond drill has been tried at Colton with poor results.

Handboring on the Burrum averages 3 or 4 feet per day down to a depth of 150 feet, beyond which progress decreases greatly. The cost may be stated as:—

2s.	6d.	per	foot	for	the first	50 feet
3s.		,,		,,	second 50	,,
3s.	6d.	,,		,,	next 25	,,
4s.		,,		,,	,, 25	,,
5s.		,,		,,	,, 50	,,

Beyond 200 or 250 feet the increase in cost is very rapid.

Though the borers always give the thickness of the strata passed through to the inch, it is doubtful if in most cases the thickness can be determined to within 3 or 4 inches, seams of coal sometimes being passed through unnoticed.

Mr. Lindsay, of the Intercolonial Wellboring Company, estimates that from 500 to 1,000 feet it would cost £1 a foot with his drop drill, the chief item being erection of machinery and cost of superintendence. As wire rope is used instead of rods, a great saving of time is made in withdrawing the tools, and in addition it is possible to bore to a depth of a couple of thousand feet. Whenever required a small core could be taken out with diamond drill.

The cost of boring by the diamond drill is seldom less than 10s. per foot, even down to 500 feet. Diamond-drilling was done by the Maryborough-Burrum Coal Company 13 years ago at a rate of 40 feet a week at 10s. per foot, exclusive of the cost of removal and supplying water, which was 4s. per foot extra (from 100 to 400 feet). The drills were not successful, as the coal was always ground up during the operation of boring.

The Burrum Coal Measures chiefly consisting of shales and soft sandstones, the calyx drill should give as good results and should be cheaper than the diamond drill.

VIII.—GENERAL REMARKS.

Uses for Coal.—The Burrum is especially a caking and gas-making coal. In the district, it is usually considered that the coal south of the Burrum River is better suited for coke-making than that on the north. Coke has been made on the south side at the Torbanlea Colliery, and is now being made at the Riverbank, but ovens have not been constructed on the north. At the Riverbank Colliery is an old nest of four beehive ovens, each 11 feet in diameter and 5 feet high, having a capacity of 5 tons of screened slack. At Torbanlea the ovens had a capacity of 7 tons of slack, and produced 4½ tons of coke. In tests the Torbanlea Coal has produced 10,280 cubic feet of gas of 15-candle light per ton.

Mr. John Henderson, C.E., manager of Maryborough Gasworks, gives the coke from the Howard coal as 67 to 69½ per cent., and the amount of gas as 10,200 cubic feet per ton, in ordinary working.

The coke is sold at the Riverbank Colliery at 30s. per ton. This is used at Aldershot, but Ipswich Coke would be much preferred, if the extra cost due to freight did not render it prohibitive.

Market for Coal.—The market for Burrum Coal is not large, though it includes the whole of Maryborough and Bundaberg and most of the Northern towns. Gympie also receives quantities of the coal. The only shipping done is that to the Northern towns, because of the friability of the coal.

The district railways do not always use Burrum Coal owing to differential rates; in fact, they are said to be using Ipswich Coal at present.

The cost of coal for shipping is 9s. 6d. at the wharf (2s. of this being freight). The cost of locally consumed coal is 9s. at the pit (8s. 6d. for a few contracts).

Age of Burrum Beds.—Fossils already described from the Burrum Series are:—

(1.) Plants: Sphenopteris, Trichomanites, Alethopteris, Thinnfeldia, Tæniopteris, Podozamites, Otozamites, Baiera.

(2.) Animals: Corbicula, Rocellaria.

Many of these are plentiful in the shales, and the only additional organisms found by me are a species of Brachyphyllum from the Riverbank Colliery, and a small pear-shaped leaflet, which is very possibly Cyclopteris, but the venation is too indistinct to be sure of this. This occurs in abundance in the shales from No. 8 Pit, Burrum Colliery.

The age of the Burrum Beds is Lower Trias-Jura, and therefore they should be covered by the Ipswich. For this reason the coal might be expected to be of better quality than that in the latter. Its friable nature is probably due to its never having been covered by any great thickness of strata, and to its only having been subjected to comparatively slight and gentle earth movements.

Surface Rock.—No fossils have as yet been found in this formation, and its age is therefore unknown. In a railway quarry about 3½ miles beyond Howard, and in one about half-a-mile north-west of Aldershot, thin-bedded fine-grained sandstones are to be seen, having a close lithological resemblance to the Maryborough Desert Sandstone Beds. At the first place the beds are arched. It is probable that the usual unstratified surface rock is younger than these thin-bedded sandstones.

Basalt.—The Goodwood Sugar Plantation is chiefly on a fine deep red basaltic soil. Originally it was scrub land, like the Isis, which in every way it resembles and with which it was probably once connected. Fragments of undecomposed basalt occur to a limited extent in the soil.

I have to thank Messrs. Robertson and Sharp, of Riverbank, and Mr. and Major Rankin, of Burrum Colliery, who assisted me in every way with information and plans. I am also indebted to Messrs. Cameron and Jones, of Maryborough, for plans, &c., relating to the properties at Aldershot and Colton.

APPENDIX 1.

Ordinary working results from Queensland Collieries Company's coal obtained by Mr. John Henderson, C.E., Manager, Maryborough Gas and Coke Company, Limited:—

	Large.	Small.
Water	1·44	1·56
Volatile hydrocarbons	31·08	28·82
Fixed carbon	65·23	62·67
Ash	2·25	6·95
Sulphur	0·61	0·55
	100·61	100·55
Coke	67·49 (very good)	69·62 (good)
Evaporating power	14·0	13·5
Gas per ton	10,200 cubic feet	
Coke per ton	1,460 lb.	
Tar per ton	110 lb. or 10½ gall.	
Ammonia liquor	116 lb. or 16 gall.	
Illuminating power	14·75 candles.	

APPENDIX 2.

Goodwood No. 1 Bore.

	Ft.	in.
Surface sand and pebbles, alluvial...	38	0
Light grey shale	3	9
Dark coaly shale	0	3
Light grey shale	4	0
Light grey shale with streaks of coal	5	10
Dark coaly shale	0	6
Light grey shale	3	8
Grey sandy shale	2	6
Gray sandstone	5	9
Dark grey coaly shale	0	9
Coal (Torbanlea ? Seam) ...	0	2
Dark grey shale ,, ...	1	4
Coal ,, ...	1	7
Grey sandy shale	2	11
Grey sandy shale	9	0
Grey sandy shale with hard iron-stone bands	7	7
Grey sandy shale	5	11
Coal	1	3
Dark coaly shale	0	9
Grey coaly shale	9	6
Grey coaly shale with hard iron-stone bands	5	3
Dark grey coaly shale	2	9
Dark grey coaly shale	3	7
Dark grey coaly shale with hard ironstone bands	9	9
Coal (Burrum ? Seam)	2	1
Dark grey coaly shale	1	7
Light grey sandy shale	3	6
Dark grey coaly shale	2	6
Grey shale with bands of ironstone	15	0
Dark grey shale	5	2
Dark coaly shale	7	5
Rich dark coaly shale	3	5
Grey shale with ironstone bands ...	15	10
Dark coaly shale	1	2
Dark grey shale	2	0
Dark grey shale with ironstone bands	1	10
Rich dark coaly shale	11	2
Dark grey coaly shale	2	0
Grey shale with ironstone bands ...	7	9
Coal (Jewel ? Seam)	1	6
Dark brown coaly shale	3	1
Dark grey shale with thick bands of ironstone	13	2
Dark grey shale with thick bands of hard ironstone	15	6
Dark grey shale with thick bands of hard ironstone	1	0
Dark grey coaly shale	3	0
Coarse stony coal	1	0
Dark coaly shale	5	0
Dark grey shale	5	0
Dark grey sandy shale with iron-stone bands	34	0
Dark grey sandy	6	10
Dark grey sandy shale with iron-stone bands	9	8
Dark grey coaly shale	6	9
Dark grey shale with ironstone bands	2	3
Dark grey sandy shale	13	4
Rich dark coaly shale	1	6
Coal (Watson ? Seam)	1	6
Light brown shale	1	8
Dark grey sandy shale	2	8
Grey shale with ironstone bands ..	5	4
	341	6

APPENDIX 3.

Howard Bores.

No. Bore.

	Ft.	in
Surface rock and clay	25	0
Shales	19	0
Coal	2	5
Clod with ironstone	1	10
Light blue stone	10	0
Coal	1	0
Coaly clay and clod	7	0
Dark clod	6	0
	94	2

No. 3 Bore.

Surface rock and clay	18	0
Shales	16	0
Coal	1	6
Clod	32	0
Coal	1	0
	68	6

No. 4 Bore.

Surface rock and clay	18	0
Shales	20	0
Blue clay	11	0
Coal (Jewel? Seam)	1	0
Band ,, ,, ...	1	0
Coal ,, ,, ...	0	9
Band ,, ,, ...	1	6
Coal ,, ,, ...	0	9
Clay ,, ,, ...	3	0
	62	1

No. 5 Bore.

Surface rock and clay	15	0
Coal (Jewel ? Seam)	0	3
Brown and yellow clay	14	0
Shale	6	0
Sandstone and ironstone	14	0
	51	2

No. 6 Bore.

Surface clay	7	0
Surface rock	6	0
Clay	19	0
Coal	0	8½
Blue coaly clod	26	0
Shale	14	0
Shale	8	0
Coal (Whitley Coal, Torbanlea ?)	3	2¾
Band ,, ,, ...	0	6
Coal ,, ,, ..	1	3½
	90	3

Bore A.

Surface clay	4	5
Surface rock, hard conglomerate ...	6	0
Clay and ironstone	7	7
Brown sandstone	1	0
Pipe clay	0	10
Clay and clay-streaked ironstone ...	1	2
Pipe clay	3	4
Blue clay	13	0
Coal and clay	0	5

Bore A—*continued.*

	Ft.	in.
Blue clay	7	8
Black band ironstone	0	2
Blue clay	5	3
Black band ironstone...	1	6
Blue clay	12	11
White clay	0	3
Coal	2	10
Sandstone	0	1
Coal	0	2
Blue clay	18	3
Very hard clay, white	2	0
Blue clod	2	0
Brick-red rotten ironstone	1	0
Clod with coal	4	0
Blue clod with coal	1	6
Bands with streaks sandstone ...	0	8
Coal	1	6
Black clod	1	7
Coal and clay mixed	1	6
Coal	0	9
Black clod	3	10
Black clod streaked with coal ...	4	0
Hard coal	0	3
Hard coal, light bands	3	10
Black band ironstone	0	2
Hard white bands	1	11
Black clod and coal	1	6
Ironstone	1	0
Black clod	0	6
Very hard light bands with pyrites	1	0
Very hard light bands	1	0
Black clod	1	0
Brown ironstone conglomerate ...	0	4
Very hard grey sandstone	3	7
Soft greenish sandstone	4	1
	140	6

Bore B.

Surface rock and clay	28	0
Black clod	2	6
Soft greenish grey sandstone ...	14	0
Hard grey sandstone	3	0
Hard gritty grey band	0	6
Soft green grey sandstone	5	3
Soft green grey sandstone	16	6
Grey clod	1	5½
Black band	0	0½
Black clod	1	0
Grey clod	2	0
Grey bands	1	6
Grey bands	2	9
Black clod with coal	3	0
Dark clod with brick-red ironstone	0	3
Black clod	4	9
Black clod streaked with coal ...	6	1
Grey bands streaked with black clod	3	4
Hard gritty grey band	0	1
Hard dark brown clod	0	1
Black clod	0	11
Black clod streaked with sandstone	6	0
Black clod	0	8
Hard grey band	0	1
Grey sandstone	2	1
	105	10

Bore C.

	Ft.	in.
Surface rock and clay	36	7
Dark grey clod	1	8
Coal and water (Burrum ? Seam) ...	0	6
Fireclay... ... ,, ...	1	9
Coal ... ... ,, ...	0	3
Fireclay and sandstone	5	6
Black clod	0	10
Light sandstone	5	1
Coal and clay	1	2
Dark fireclay	2	5
Lighter fireclay	1	0
Blue clay	2	6
Black clod	0	8
Black clod with coal	1	11
Grey bands	1	10
Ironstone	0	2
Dark clod streaked with coal ...	2	2
Coaly clod	0	2
Grey sandstone	0	1
Ironstone	0	2
Brown clod and grey sandstone ...	2	4
Brown clod streaked with coal ...	2	0
Brown clod streaked with grey sandstone	0	5
Grey sandstone	4	8
Ironstone	0	2
Hard grey sandstone...	15	4
Hard grey sandstone and clod ...	1	3
Dark clod and light fireclay ...	0	6
Sandstone and clod	9	1
	102	0

Bore D.

Surface rock and clay	18	0
Blue clay	2	1
Dark clod	3	0
Dark clod with grey sandstone ...	2	0
Yellow sandstone	2	2
Dark clod	2	2
Yellow sandstone	6	10
Dark clod streaked with sandstone	4	6
Dark clod	2	6
Light clod	0	10
Very black clod with coal	0	11
Light fireclay	4	0
Dark fireclay	2	6
Coal and clay	0	2
Dark fireclay	1	6
Stony fireclay with sand	2	2
Grey sandstone with thin streaks of coal	0	5
Brown clod	0	10
Grey sandstone	1	3
Dark clod with coal	3	7
Ironstone	1	2
Dard clod	1	0
Grey sandstone	10	8
	74	3

Bore E.

Surface rock and clay	35	6
Dark brown clod	1	0
Coal	0	2
Light fireclay	3	7
Dark fireclay	2	1
Black clod	2	0

APPENDIX 3—*continued.*

HOWARD BORES—*continued.*

BORE E—*continued.*

	Ft.	in.
Fireclay	3	6
Fireclay streaked with grey sandstone	11	6
Black clod	2	8
Coal (Torbanlea ? seam)	3	4
Coaly clod ,, ,,	0	6
Coal ,, ,,	1	2
Coaly clod	0	5
Light fireclay	2	7
Coaly clod	2	6
Fireclay	3	3
Dark brown clod	0	11
Strong fireclay	6	1
Fireclay and grey sandstone	1	0
Ironstone	0	4
Grey sandstone with ironstone nodules	4	9
Fireclay and ironstone	0	2
Fireclay and sandstone	3	11
Grey sandstone	6	0
Fireclay and sandstone	0	11
Sandstone	2	0
Sandstone and fireclay	1	5
Sandstone and fireclay	2	9
Sandstone and fireclay	3	0
Ironstone	0	4
Sandstone	1	9
Light clod	0	9
Dark clod	1	0
Coaly clod (Burrum ? seam)	1	0
Dark clod ,, ,,	2	3
Coal ,, ,,	1	3
Dark coaly clod	1	10
Coal	0	7
Coaly clod	0	7
Coaly clod	2	0
Fireclay streaked with grey sandstone	1	4
Light clod	0	7½
Ironstone	2	5
Dark clod	0	3½
Dark coaly clod	3	2
Dark shale streaked with sandstone	2	10
Grey sandstone and fireclay	2	0
Coaly clod	1	9
Fireclay	0	5
Sand shale	1	1
	138	3

BORE F.

Surface rock and clay	44	4
Dark fireclay	2	0
Dark fireclay with grey sandstone	1	4
Grey sandstone	4	0
Grey sandstone	4	0
Grey sandstone with fireclay	3	0
Light fireclay	1	0
Light fireclay with a little clod	0	4
Ironstone	0	2
Grey sandstone and coal	1	0
Grey sandstone and dark fireclay	3	6
Light sandy fireclay	1	0
Sandstone	2	0
Light sandy fireclay	1	0
Grey sandstone and fireclay	5	9
Dark clod and sandstone	3	6
Coal	1	10
Fireclay	0	9
Dark coaly clod	0	7
Coal	1	2
Strong fireclay	3	8
Brown clod	0	6
Fireclay with streaks of sandstone	3	0
Ironstone	0	3
Dark clod	0	9
Dark clod	1	2
Dark clod	0	3
Soft coal	0	3
Fireclay	7	4
Coaly clod	0	10
Coal (Jewel ?)	1	0
Fireclay ,,	4	4
Coal ,,	0	8
Shaly clod with a little coal	2	3
Sandstone	3	8
Ironstone	0	3
Very hard sandstone	32	0
	141	11

BORE G.

Surface rock and clay	18	0
Hard clay, &c.	26	0
Sandstone and fireclay	28	0
Coal	0	5
Band	3	6
Coal	2	0
Fireclay	5	0
Sandstone and fireclay	25	0
Grey sandstone	22	0
	129	11

BORE H.

	Ft.	in.
Surface rock and clay	35	6
Shale	3	0
Soft shaly sandstone	9	0
Green shale and sandstone	3	0
Green sandstone	8	0
Green sandstone	18	0
Green shaly sandstone	6	0
Coaly clod	2	0
Grey sandstone	8	0
Sandy fireclay	2	0
Coaly clod	4	0
Fireclay	4	0
Green sandstone	2	0
Green coaly clod	3	0
Green sandstone	16	0
Green sand with hard dark bands	4	0
Green streaky sandstone	8	0
Hard shale with ironstone	8	0
Green sandstone	2	0
	150	6

BORE I.

Surface rock and clay	45	0
Shaly sandstone	4	0
Hard grey sandstone with coal streaks	6	0
Grey shaly sandstone	6	0
Grey shaly sandstone	6	0
Coaly clod	1	0
Dark shale	6	0
Shale with sandstone	18	0
Green sandstone	2	0
Hard shale streaked with green sandstone	35	0
Coal	4	0
Coaly clod	0	6
Hard shale streaked with grey sandstone	10	0
Grey sandstone	2	0
	150	1

BORE J.

Surface rock and clay	22	0
Shales	17	8
Coal	1	9
Shale	3	0
Coal	1	0
Shales	18	0
Coal (Beaufort ? Seam)	0	8
Band ,, ,,	3	0
Coal ,, ,,	0	3
Band ,, ,,	3	0
Coal ,, ,,	1	6
Shales ,, ,,	6	0
Coal ,, ,,	2	0
Shales	6	0
Coal	1	0
Shales	6	0
Coal	1	2
Shales	40	0
Coal	0	6
Band	2	0
Coal	0	3
Fireclay and shale	10	0
Fireclay and coal	0	6
Fireclay	3	0
Shale and sandstone	4	0
	148	9

BORE K.

Surface rock and clay	33	0
Shales	20	0
Fireclay	10	0
Sandstones and shale	30	0
Coal	0	4
Sandstone and shale	16	0
Coal	0	9
Fireclay and shale	5	0
Shales and sandstones	15	0
Shales	4	0
Ironstone	1	0
Fireclay	8	0
Sandstone	4	0
	147	1

No. 1 SHAFT (Whitley's)

Surface rock and clay	23	0
Shales	2	0
Coal	1	0
Shales	3	0
Coal	8	0
Band	1	0
Coal	1	6
Band	6	0
Coal	2	0
Shale	14	0
Coal	1	0
Shale	6	0
Coal	1	2
Shales	40	0

No. 1 SHAFT (Whitley's)—*continued.*

	Ft.	in.
Coal (Torbanlea)	0	6
Band ,,	1	0
Coal ,,	3	0
	106	10

No. 8 PIT BORE.

Gray shale with coal	8	6
Coal	2	4
Shale	1	6
Ironstone	0	4
Coal	0	4
Shale	9	10
Coal	0	2
Shale with coal	7	6
Hard sandstone	0	4
Coal (stony) (Burrum ? Seam)	1	6
Shale ,, ,,	0	2
Coal (shaly) ,, ,,	1	6
Sandstone	0	6
Shale	2	0
Coal	0	6
Shale	1	0
Sandstone with coal	6	0
Shale	10	0
Shale with coal	4	0
Shale	6	0
Sandstone	0	6
Coal	0	9
Shale	0	3
Coal	1	0
Shale	5	0
Coal	0	6
Shale with coal	4	6
Sandstone	0	6
Shale	1	0
Sandstone with coal and shale	13	0
Shale	3	0
Shale with coal	5	0
Shale	5	0
Coal and shale alternating 6 in. apart	4	0
Sandstone	4	0
Sandstone with 1 inch to 2 inches coal every 6 inches	2	0
Sandstone	4	0
Coal	0	6
Sandstone	1	6
Sandstone and coal	2	0
Shale and water	0	6
Shale and coal	0	6
Sandstone and coal	4	6
Shale with sandstone and 1 inch coal bands	4	6
Shale	11	6
Sandy shale with coal	2	0
Shale	4	6
	150	0

No. 1 Q.C. COMPANY'S SHAFT.

Surface formation	41	10
Clay and shale	26	2
Coal	2	1
Clay and shale	13	4
Coal	1	0
Fireclay and shale	6	6
Coal	0	9
Fireclay and shale	17	11
Sandstone	13	8
Ironstone	0	3
Coaly shale and fireclay	14	4
Coal	0	6
Coaly shale	3	6
Coal	0	3
Shale and fireclay	9	0
Coal	0	7
Shale	0	4
Coal	0	4
Black shale	0	6
Coal	0	3
Fireclay	2	8
Sandstone with ironstone	7	8
Clay	1	11
Coal	0	9
Shale and fireclay	5	1
Shale and ironstone	5	10
Sandy clay	3	0
Coal	0	3
Fireclay and shale and ironstone	4	8
Coal	0	3
Fireclay	6	11
Sandstone and ironstone	4	5
Shale	7	2
Shale	3	4
Coal (Torbanlea ? Seam)	0	6
Shale ,, ,,	1	1
Coal ,, ,,	1	1
Shale ,, ,,	1	6
Coal ,, ,,	0	11
Fireclay and shale	16	1
Coal	0	9
Fireclay with nodules	3	9
	225	8

APPENDIX 4.

Burrum and Torbanlea Bores.

No. 1. Bore.

Western corner of Selection 19, Walsh.

	Ft.	in.
Surface rock and clay	56	9
Grey sandstone	6	9
Dark shale	3	0
Coal	0	3
Dark coaly shale	2	9
Iaonstone	0	6
Fireclay	2	0
	72	0

No. 2 Bore.

162 yards to rise of No. 1.

	Ft.	in.
Surface	26	8
Grey shale	2	4
Grey rusty shale	2	6
Shales	7	11
Dark coaly shale	5	7
Coal (Bridge Seam)	1	7
Coal band ,, ,,	0	3
Coal ,, ,,	0	4
Grey shale ,, ,,	1	2
Coal ,, ,,	0	4
Shales	13	7
Coal	0	9
Coaly shale	0	6
Coal	0	9
Shales (dark)	10	9
Coal	0	7
Sandy shale	6	5
Grey shale	6	6
	89	6

No. 3 Bore.

115 yards to rise of No. 2.

	Ft.	in.
Surface	27	6
Shales	7	7
Coal	0	5
Shales	3	10
Green sandstone	1	1
Shales	18	10
	59	3

No. 4 Bore.

To east and 59 yards to rise of No. 2.

	Ft.	in.
Surface rock	32	0
Shales	25	0
Dark coaly shale	9	1
Shale	5	11
	72	0

No. 5 Bore.

198 yards to dip of No. 1 Bore.

	Ft.	in.
Surface rock	21	0
Sandstone (yellow and grey)	36	6
	57	6

No. 6 Bore.

134 yards to dip of No. 1 Bore.

	Ft.	in.
Surface rock	19	0
Yellow and grey sandstone	2	3
Shales	27	0
Coal	1	6
Coaly shale	11	11
Coal	0	5
Coaly shale	3	2
Coal	2	0
Coaly shale	3	9
Grey shale	2	6
	86	6

No. 7 Bore.

120 yards to dip of Walsh's Mine on bank.

	Ft.	in.
Surface shale	42	0
Shales	30	4
Coaly shale	15	3
Coal (Torbanlea Seam)	1	0
Coaly band ,, ,,	0	4
Coal ,, ,,	0	10
Dark coaly shale	1	3
	91	0

No. 8 Bore.

27 yards to dip of Walsh's Mine.

	Ft.	in.
Surface	46	6
Shales	17	1
Coal (Burrum Seam)	3	7
Dark coaly shale	2	10
	70	0

No. 9 Bore.

120 yards from inner corner 19 Walsh towards Maryborough Road.

	Ft.	in.
Surface	21	8
Shales	4	8
Coal	0	3
Coaly shale	4	2
Coal	0	3
Coaly shales	6	3
Coal	0	5
Coaly shales	4	3

No. 9 Bore—*continued.*

	Ft.	in.
Coal	0	2
Coaly shales	2	10
Sandy	5	3
Grey sandstone	9	3
	59	0

No. 10 Bore.

150 yards to rise of No. 9.

	Ft.	in.
Surface	16	6
Sandstone yellow and grey	25	0
	41	6

No. 11 Bore.

60 yards to rise of No. 10.

	Ft.	in.
Surface	12	0
Yellow and grey sandstones	33	10
Coaly shale	2	2
Coal	1	10
Coaly shale	0	5
Coal	0	3
Dark shale	7	8
Coal	0	3
Grey coaly shale	2	1
Grey sandy shale	6	0
	66	6

No. 12 Bore.

80 yards to rise.

	Ft.	in.
Surface	17	0
Brown shale	1	0
Coal	0	8
Brown coaly shale	0	4
Coal	0	3
Brown coaly shale	1	7
Coal	3	0
White clay	0	11
Shales	18	6
Coal	0	3
Shale	6	0
Coal	1	1
Coaly shale	4	8
Coal	0	4
Dark sandy shale	7	2
	72	0

No. 13 Bore.

17 chains to rise of No. 11 Bore.

	Ft.	in.
Surface	23	0
Shale	8	6
Coal (Torbanlea Seam)	1	1
Dark shale ,, ,,	0	3
Coal ,, ,,	2	11
Dark coaly shale	0	6
Hard grey shale	3	9
	40	0

No. 1 Trial Shaft.

40 yards to dip of No. 13.

	Ft.	in.
Surface	32	0
Coal (Torbanlea Seam)	1	10
Dark shale ,, ,,	2	5
Coal ,, ,,	1	6
Dark shale ,, ,,	1	3
Coal ,, ,,	1	6
	40	6

No. 14 Bore.

13 yards to dip of No. 2 Trial Shaft.

	Ft.	in.
Surface	19	0
Shale	9	0
Coal	0	7
Coaly shale	14	11
Coal (Torbanlea Seam)	2	7
Coaly shale ,, ,,	2	5
Coal ,, ,,	1	6
Dark shale ,, ,,	1	3
Coal ,, ,,	1	2
Dark shales	10	7
Ironstone	0	4
Shale	24	1
Coal (Burrum Seam)	1	4
Shale ,, ,,	0	3
Coal ,, ,,	3	1
Coaly shale	0	11
	93	0

No. 15 Bore.

	Ft.	in.
Surface	21	10
Coal (Torbanlea Seam)	0	7
Clay ,, ,,	1	4
Coal ,, ,,	0	9
Clay ,, ,,	0	3
Clay and coal	0	6
Clay and shale	1	4
Coal	0	9
Sandy shale	36	11
Coal (Burrum)	1	2
Band ,,	0	5
Coal ,,	2	8
Shale	0	6
	69	0

No. 16 Bore.

To dip of No. 2 Trial or Air Shaft.

	Ft.	in.
Surface	27	0
Shale	6	4
Coal (Torbanlea Seam)	2	10
Shale ,, ,,	1	3
Coal ,, ,,	2	0
Shale ,, ,,	2	8
Coal ,, ,,	0	6
Coaly shale	3	5
	46	0

No. 17 Bore.

44 yards to rise of No. 16.

	Ft.	in.
Surface	24	0
Shale	16	9
Coal (Burrum Seam)	1	3
Band ,, ,,	1	2
Coal ,, ,,	2	5
Shale ,, ,,	1	5
	47	0

No. 2 Trial or Air Shaft.

To rise of 16.

	Ft.	in.
Surface	23	0
Sandstone	13	0
Coal (Burrum Seam)	1	2
Shale ,, ,,	1	3
Coal ,, ,,	2	2
Fireclay		
	40	7

No. 1 Air Shaft.

To dip of No. 2 Trial.

	Ft.	in.
Surface	45	0
Coal	0	9
Shale	8	3
Coal (Torbanlea Seam)	2	7
Band ,, ,,	2	5
Coal ,, ,,	1	6
	60	6

No. 18 Bore.

30 yards to dip of No. 12.

	Ft.	in.
Surface	2	0
Sandstone	25	0
Coal and shale	6	0
Fireclay	9	0
	42	0

No. 19 Bore.

30 yards to dip of No. 18 and 5 chains from boundary.

	Ft.	in.
Surface	15	0
Yellow and grey sandstone	33	0
Coaly shale	38	0
	67	0

No. 20 Bore.

To rise of pit.

	Ft.	in.
Surface	30	0
Shale	28	0
Grey sandstone	14	11
Ironstone	1	1
Grey sandstone	2	0
	76	0

No. 21 Bore.

1½ chains to dip of 20.

	Ft.	in.
Surface	25	0
Yellow sandstone	5	4
Coal	1	1
Coaly shale	7	4
Coal (Watson's Seam)	2	1
Shale ,, ,,	2	7
Coal ,, ,,	2	1
Shale	2	6
	48	0

No. 22 Bore.

13 chains to rise of No. 21.

	Ft.	in.
Surface	19	0
Shale	27	4
Grey sandstone	3	8
Grey shale	15	5
Coal	1	1
Shale	18	6
Coal	9	0
Shale	24	3
	110	0

No. 2 Torbanlea Shaft.

	Ft.	in.
Surface rock	18	0
Soft brown shale	9	0
Crop coal	0	6
Shales	33	0
Coal with 6-inch clay band	3	0
Shale	1	6
Shale and coal	9	6
Sandy shale	5	6

APPENDIX 4—*continued.*

BURRUM AND TORBANLEA BORES—*continued.*

No. 2 TORBANLEA SHAFT—*continued.*

	Ft.	in.
Grey sandstone	89	0
Coaly shale	2	0
Fireclay	2	6
Coaly shale	2	9
Fireclay	4	6
Coal (Bridge Seam)	0	6
Fireclay ,,	3	3
Coal ,,	2	0
Fireclay	5	6
Shales	31	9
Bituminous blais and parrot	0	6
Shales and ironstone	12	0
Fireclay	22	0
Coal	0	9
Fireclay	1	3
Coal	0	7
Fireclay	3	9
Shales	8	0
Bituminous blais	2	0
Fireclay	12	9
Shales	33	3
Coal	1	6
Shale	7	0
Coal (Torbanlea Seam)	1	4
Shale ,, ,,	4	4
Coal ,, ,,	1	4
Band ,, ,,	0	10
Coal ,, ,,	0	8
Band ,, ,,	1	2
Coal	0	8
Coaly shale	27	6
Coal (Burrum Seam)	1	0
Band ,, ,,	0	9
Coal ,, ,,	5	0
Fireclay	1	8
Coal	2	0
Fireclay	2	0
Coal	0	6
Fireclay	3	0
Bituminous blais	3	0
	396	3

No. 23 BORE.

50 yards S.E. of No. 21.

Surface	23	0
Yellow and grey sandstone	21	9
Coal	2	1
Grey shales	7	3
Coal (Watson's Seam)	1	11
Coaly band ,,	2	5
Coal ,,	1	10
Shale	1	6
	61	9

No. 24 BORE.

100 yards S.E. of No. 23 and to dip.

Surface	21	8
Crop coal (Jewel ? Seam)	0	3
Shale	7	9
Coal	0	6
Shale	8	10
Yellow and grey sandstone	53	8
Sandy shale	0	6
Coal	1	10
Dark coaly shale	14	6
Coal (Watson's Seam)	1	10
Band ,,	1	11
Coal ,,	2	6
Shale	1	5
	117	3

No. 3 AIR SHAFT.

300 yards S.E. of No. 1 and 250 yards S.W. of No. 2 Pit.

Surface	22	6
Crop coal	0	7
Dark shales	43	11
Coal (Torbanlea Seam)	4	3
Band ,,	1	6
Coal ,,	1	8
Grey shale	0	7
	75	0

(No. 26 bored from bottom of this shaft.)

No. 25 BORE.

90 yards S.E. from No. 24 Bore.

Surface	34	0
Yellow grey sandstone	42	10
Coal (Watson's Seam)	1	7
Coaly shale	1	7
Coal	0	7
Shale	17	7
Coal	2	1
Shale	5	3
Coal	2	2

No. 25 BORE—*continued.*

	Ft.	in.
Band	1	10
Coal	1	9
Shale	1	9
	113	0

No. 26 BORE.

From bottom of No. 3 Air Shaft.

Grey shale	1	10
Coal (Torbanlea)	0	9
Grey shale	37	9
Coal (Burrum Seam)	1	11
Band ,, ,,	0	3
Coal ,, ,,	2	2
Dark coaly shale	4	2
Coal	0	8
Shale with ironstone in parts	69	3
Coal (Jewel Seam)	2	0
Shale	2	9
	199	6

No. 27 BORE.

140 yards to rise of No. 3 Air Shaft.

Surface	34	0
Sandy shale	42	10
Coal	3	0
Coaly shale	1	11
Coal (Jewel Seam)	1	11
Band	1	10
Coal	1	0
Band	0	2
Coal	1	1
Shale	7	9
Grey sandstone	4	6
	99	10

No. 28 BORE.

45 yards to dip of No. 24 Bore.

Surface	26	0
Yellow and grey sandstone	21	0
Sandy shale	9	0
Coal (Jewel Seam)	2	10
Coaly band ,,	0	6
Coal ,,	1	2
Shale	8	0
Coal	0	9
Shale	6	9
Grey sandstone	1	6
	77	6

No. 29 BORE.

9 chains to rise of No. 24.

Surface clay	16	0
Shale and ironstone	10	0
Brown sandstone	20	0
Grey coaly shale	1	6
Coal	0	9
Band	2	0
Coal	1	10
Band	3	11
Coal	0	3
Shales	40	3
Coal (Hartley's Seam)	0	8
Shales ,,	5	2
Coal ,,	1	3
Shales	6	5
	110	0

No. 30 BORE.

6 chains to rise of No. 24.

Surface	39	0
Shale	21	0
Sandstone	18	0
Shale	8	0
Grey sandstone	24	6
Shale	1	0
Coal	0	3
Band	2	2
Coal	2	1
Coaly shale and fireclay	2	6
	121	0

No. 31 BORE.

12 chains to rise of No. 24.

Surface clay and conglomerate	8	0
Shale	11	9
Crop coal (Hartley's Seam)	0	2
Band	0	2
Coal	0	7
Shale	0	4
Coal	0	2
Shale	1	0
Coal	0	6
Band	7	0
Coal	1	2
Shale	14	2

No. 31 BORE—*continued.*

	Ft.	in.
Sandy shale with ironstone	76	3
Coaly shale and coal	2	9
Coaly shale	3	7
	127	7

No. 34 BORE.

12 chains S. 37 degrees E. from No. 3 Pit (Air Shaft) and to the dip.

Surface clay	3	9
Shales	41	0
Coal	0	3
Shale	3	5
Coal	0	1
Coaly shale	1	4
Coal	0	4
Coaly shales	54	9
Coal	0	2
Band	1	10
Coal	1	9
Shale	7	3
Coal (Torbanlea Seam)	0	9
Shale	0	6
Fireclay	4	2
Coaly shale	2	10
Coal	0	1
Fireclay	0	9
	125	0

No. 35 BORE.

18 chains S. 37 degrees E. and 35 yards to dip from No. 3 Air Shaft.

Surface clay, &c.	25	6
Brown shale with coal	12	6
Coaly shale	6	4
Coal	0	2
Band	1	0
Coal	0	3
Coaly shale	37	1
Coal	0	5
Band	5	7
Coal	0	2
Fireclay and shale (Torbanlea Seam)	1	10
Coal	0	2
Band	0	3
Coal	0	11
Coaly shale	35	3
Coal	0	1
Shale and fireclay	2	1
Coal	0	7
Shale	1	10
	132	0

No. 36 BORE.

3·36 chains to rise of No. 33.

Surface clay and rock	25	6
Light sandy shale	11	6
Grey sandstone with coal streaks	18	0
Shales	16	0
Coal	0	9
Coaly shale	1	8
Sandy shale with ironstone	7	1
Grey sandstone	19	0
Coal and sandy shale	11	6
Sandy shale and ironstone	5	6
Grey sandstone	3	0
Sandy shale with ironstone	5	6
	125	0

No. 37 BORE.

101 yards from No. 36 towards Maryborough-Bundaberg road, and 31 yards from boundary.

Surface rock and clay	28	6
Shales	19	6
Shales with ironstone	59	6
Ironstone	2	0
Shales with ironstone	15	6
	125	0

No. 38 BORE.

40 yards to dip of No. 27 and 100 yards to rise of No. 3 Air Shaft.

Surface	18	6
Shales	11	3
Coal (Burrum Seam)	2	0
Band ,, ,,	0	5
Coal ,, ,,	0	11
Coaly shale	5	4
Coal	0	4
Shales	74	7
Coal	1	4
Coal boulder	0	4½
Coal	1	1
Coaly shale (Jewel Seam)	3	0
Coal	1	3½
	120	5

APPENDIX 4—*continued.*

BURRUM AND TORBANLEA BORES—*continued.*

No. 40 BORE.

18 yards to rise of No. 17 and 18 yards S.E. of it.

	Ft.	in.
Surface	10	6
Shales	17	9
Coal crop (Burrum Seam)	0	9
Band ,, ,, ...	1	5
Coal ,, ,, ...	1	11
Coaly shale	2	8
Brown shale	18	0
Grey plies	59	10
Coaly shale	0	3
Coal (Jewel Seam)	2	9
	115	10

No. 42 BORE.

9 chains from Torbanlea boundary and 20 yards from S.W. boundary of portion 34.

Surface	25	0
Shale	4	0
Coal	1	2
Shale	10	1
Coal (Torbanlea Seam)	3	3
Band ,, ...	0	11
Coal ,, ...	0	7
Band	20	0
Coal	0	7
Band	3	8
Coal	1	1
Shale	21	9
Coal	1	4
Shale	6	0
Coal	0	3
Shale	0	6
Coal (Burrum Seam)	1	10
Shale ,, ...	0	4
Coal ,, ...	0	3
Dark coaly shale	1	6
Coal	1	0
Coaly shale	3	6
	113	6

No. 43 BORE.

2½ chains from Company's boundary on line of level of No. 37, and ½ chain to rise of it.

Surface	35	0
Shale	34	10
Coal	0	3
Shale	2	1
Coal	1	0
Shale	5	10
Coal	0	4
Dark coaly shale	6	2
Coal	0	7
Shale	0	3
Coal	0	3
Shale	22	5
Coal (Burrum Seam)	1	9
Shale ,, ,, ...	1	2
Coal ,, ,, ...	1	11
Dark coaly shale	1	0
	114	10

No. 44 BORE.

5 chains from S.E. boundary, 35 yards dip level.

Surface	31	0
Shales	27	0
Coal	2	2
Shale	6	0
Coal	0	6
Shale	3	4
Coal (Torbanlea Seam)	2	3
Shale ,, ,, ...	1	0
Coal ,, ,, ...	0	9
Shale	32	7
Coal	10	0
Shale	9	6
Coal	0	3
Shale	0	8
Coal	0	8
Shale	5	8
Coal	0	3
Shale	2	10
Coal (Burrum ? Seam)	0	10
Shale ,, ,, ...	0	8
Coal ,, ,, ...	1	4
Shale ,, ,, ...	5	5
	135	6

No. 41 BORE.

5 chains on strike from No. 40, and 15 yards to rise, and ½ chain from Brown's Boundary.

Surface	6	0
Light shale with ironstone	26	3
Coal crop	0	1
Brown shale with coal	7	8

No. 41 BORE—*continued.*

	Ft.	in.
Shale with ironstone	62	0
Rich coaly shale	1	6
Dirty soft coal...	0	10
Coaly band	1	2
Sooty pyritous coal	1	0
Rich coaly band	0	9
Brown shaly band (Jewel Seam) ...	2	0
Good clean coal	0	8
Shale	5	1
	115	0

No. 4 AIR SHAFT.

Between Nos. 27 and 38, 8 chains from No. 3 Pit.

Unrecorded strata	85	0
Top coal (Jewel Seam)	2	9
Band ,, ,, ...	1	6
Bottom coal ,, ,, ...	1	6
Full of ironstone.		

No. 45 BORE.

5 chains into Brown's Land, level course.

Surface	31	0
Shales	20	2
Top coal (Torbanlea Seam)	3	3
Band ,, ,, ...	0	6
Bottom coal ,, ,, ...	1	3
Dark coaly shale	4	10
	61	0

BROWN'S BORE.

10¼ chains beyond No. 46, in Brown's Ground.

Surface	29	0
Shale	4	1
Coal	2	2
Shales	8	5
Coal	2	2
Dark shales	15	5
Coal (Burrum Seam)	0	4
Band ,, ,, ...	0	2
Coal ,, ,, ...	0	5
Band ,, ,, ...	0	6
Coal ,, ,, ...	3	6
Shales	1	6
	67	8

No. 46 BORE.

9¼ chains beyond Air Shaft.

Surfaces	26	0
Dark shale	60	1
Coal (Torbanlea Seam)	0	7
Band ,, ,, ...	0	5
Coal ,, ,, ...	3	5
Shales	24	0
Coal	2	3
Dark shales	18	11
Coal (Burrum Seam)	1	6
Band ,, ,, ...	0	5
Coal ,, ,, ...	2	1
Shale	1	4
	117	0

BORE IN FACE OF N.W. LEVEL N. OF TROUBLE.

Strata	51	0
Coal	2	3
Band (Burrum Seam)	3	0
Coal ,, ,, ...	2	11
Band ,, ,, ...	0	8
Coal	1	8
	61	6

No. 47 BORE IN PORTION 49, S.E. OF No. 42.

Surface	25	0
Shales	48	10
Coal (Torbanlea Seam)	0	3
Shale ,, ,, ...	2	2
Coal ,, ,, ...	0	6
Band ,, ,, ...	0	2
Coal ,, ,, ...	2	3
Band ,, ,, ...	0	4
Coal ,, ,, ...	0	3
Shale	2	9
	82	6

No. 48.

12 Chains S. from No. 25.

Surface	32	6
Grey shale	1	2
Crop coal	1	8
Shale	8	9
Coal	0	8
Dark shale	3	2
Coal	2	3
Coaly shale	3	6

No. 48 BORE—*continued.*

	Ft.	in.
Coal (Watson's Seam)	1	7
Shale ,, ,, ...	2	1
Coal ,, ,, ...	1	10
Dark shale	5	4
	64	6

No. 49 BORE.

Centre of Block 34, 20 chains 11 yards above boundary.

Surface	23	0
Dark shales	18	2
Coal (Torbanlea Seam)	1	1
Band ,, ,, ...	0	7
Coal ,, ,, ...	2	4
Shale	4	3
Coal	0	4
Shale	9	8
Coal	0	8
Coaly shale	1	11
Coal	0	6
Shale	3	8
Coal	0	9
Dark shale	8	7
Sandy shale	27	3
Coal	0	4
Dark shales	9	9
Coal (Burrum Seam)	0	9
Coaly shale ,, ,, ...	0	11
Coal ,, ,, ...	1	3
Coaly shale	1	3
	117	0

No. 50 BORE.

About 180 yards to rise of No. 49.

Surface	30	0
Sandstone	9	0
Shales	2	9
Crop coal	0	8
Dark shales	5	11
Coal (Watson's Seam)	1	6
Shale ,, ,, ...	1	0
Coal ,, ,, ...	1	8
Shale	3	6
Coal	0	4
Shale	0	10
Coal	0	6
Shales	7	10
	65	6

No. 51 BORE.

80 yards to dip of No. 49.

Surface	23	6
Shales	50	4
Coal	0	6
Shale	1	3
Coal	0	4
Shale	1	0
Coal (Torbanlea Seam)	1	0
Shale ,, ,, ...	0	5
Coal ,, ,, ...	2	6
Shale	1	1
	81	11

B.S. AND D. BORES.

At face of No. 1 Stone drive.

Shales	40	6
Coal	1	4
Band	1	2
Coal (Burrum Seam)	0	2
Band ,, ,, ...	0	10
Coal ,, ,, ...	0	8
Band ,, ,, ...	0	4
Coal	1	8
Shales	0	3
	46	11

DOOK BORE TO RISE OF SHAFT.

Surface	39	6
Shales	38	6
Coal	0	10
Shale	6	6
Coal	0	4
Shale	2	6
Coal	0	4
Shales	16	6
Sandstone	69	9
Shale	0	3
Coal (Watson's ? Seam)	0	10
Shale ,, ,, ...	1	0
Coal ,, ,, ...	1	2
Shale ,, ,, ...	1	3
Coal ,, ,, ...	0	3
Shale	2	6
Coal	0	6
Shale	3	3
Shaly sandstone	3	0
	186	4

APPENDIX 5.

Marlborough-Burrum Coal Company's Bores, Colton.

NORTHERN LINE.

	Ft.	in.	
No. 1.—186	1	deep.	—No indications of coal.
No. 2.—131	7	„	„ „
No. 3.—127	5	„	Coal—2 ft. 8 in. at 93 ft. 6 in. depth.
No. 4.—121	5	„	„ indications.
No. 5.—122	5	„	„ 1 ft. 2 in. at 35 ft. depth.
No. 6.— 85	5	„	„ 1 ft. 10 in. at 80 ft. depth.
No. 7.—120	0	„	„ 8 in. at 40 ft. depth.
No. 8.—138	0	„	„ 9 in. at 54 ft. depth; 3 ft. 8 in. at 67 ft. depth, and 1 ft. 1 in. at 103 ft.
No. 9.—136	7	„	„ 1 ft. 2 in. at 22 ft. 6 in. depth; 1 ft. 1 in. at 31 ft. depth; 4 ft. 11 in. at 131 ft., Glenesk.
No. 10.—160	6	„	„ 8 in. at 27 ft. depth; 7 in. at 28 ft. 6 in. depth; 9 in. at 62 ft. depth; 8 in. at 72 ft. depth; 6 in. at 92 ft. depth; 6 in. at 132 ft. depth; 4 ft. 5 in. (5 in. band) at 153 ft. 7 in. depth, Torbanlea?
No. 11.—136	0	„	„ 1 ft. 7 in. at 91 ft. depth. Sandstone under surface.
No. 12.—175	5	„	„ 1 ft. 4 in. at 16 ft. depth; 7 in. at 21 ft. depth; 1 ft. 8 in. at 24 ft., Torbanlea? 1 ft. 4 in. at 39 ft. depth; 6 in. at 62 ft. depth; 4 in. at 105 ft.; 3 ft. 2 in. at 172 ft 4 in. depth, Jewel?
No. 13.—132	5	„	„ 4 in. at 16 ft. depth; Watson's? 1 ft. 2 in. at 34 ft. depth; 1 ft. 8 in. at 51 ft. depth; 1 ft. 4 in. at 60 ft.
No. 14.—140	0	„	„ 7 in. at 42 ft.; 2 ft. 6 in. at 106 ft.; 1 ft. 1 in. at 110 ft. 9 in.; 1 ft. 7 in. at 121 ft.; 6 in. at 124 ft.; 11 in. at 126 ft.
No. 15.—161	0	„	„ 3 ft. at 117 ft.; 11 in at 133 ft.; 2 ft. 10 in. at 144 ft.; 1 ft. 9 in. at 148 ft.; 2 ft. 3 in. at 155 ft., Hartley? Seam.
No. 16.—130	5	„	„ 1 ft. 3 in. at 28 ft.; 9 in. at 34 ft.; 7 in. at 42 ft.
No. 17.—164	0	„	„ 3 ft. 9 in. at 106 ft., Torbanlea?
No. 18.—130	0	„	„ 3 ft. 1 in. at 99 ft., Glenesk?; 1 ft. 1 in. at 101 ft. 3 in.; 2 ft. 6 in. (10 in. band) at 115 ft.
No. 19.— 38	5	„	„ 3 ft. 5in. at 50 ft.

SOUTHERN LINE.

	Ft.	in.	
No. 1.—101	1	deep.	—No coal.
No. 2.—111	5	„	„
No. 3.— 94	5	„	„
No. 4.—133	5	„	Coal—9 in. at 44 ft.; 1 ft. 2 in. at 95 ft.; 1 ft. 4 in. at 121 ft.
No. 5.—114	5	„	„ 4 in. at 72 ft.; 7 in. at 83 ft.; 10 in. at 91 ft.; 8 in. at 110 ft.
No. 6.—121	0	„	„ 8 in. at 35 ft.; 7 in. at 53 ft.; 1 ft. 2 in. at 66 ft.; 4 in. at 75 ft.; 10 in. at 80 ft., Glenesk?
No. 7.—110	5	„	„ 8 in. at 34 ft.; 5 in. at 40 ft.; 6 in. at 56 ft.; 3 ft. 1 in. at 75 ft.; 1 ft. 4 in. at 81 ft., Hartley?
No. 8.—130	0	„	„ 2 in. at 25 ft.; 8 in. at 57 ft.; 1 ft. 1 in. at 71 ft.; 1 ft. at 82 ft.; 11 in. at 161 ft.; 1 ft. 2 in. at 122 ft., Hartley?
No. 9.—136	7	„	„ 8 in. at 49 ft.; 10 in. at 74 ft.; 10 in. at 80 ft.; 8 in. at 107 ft.; 4 in. at 121 ft.; 1 ft. 1 in. at 123 ft., Hartley?
No 10.—115	0	„	„ 6 in. at 37 ft.; 9 in. at 43 ft.; 3 in. at 46 ft.; 6 in. at 70 ft.
No. 11.— 92	0	„	No data.
No. 12.—120	1	„	Coal—3 ft. 1 in. (1 ft. 1 in. band) at 44 ft., Jewel?
No. 13.—125	5	„	„ 1 ft. 11 in. at 40 ft.; 6 in. at 44 ft.; 1 ft. 2 in. at 46 ft., Jewel? 10 in. at 90 ft.; 1 ft. 3 in. at 93 ft.
No. 14.— 98	0	„	„ 1 ft. 7 in. at 83 ft.; 8 in. at 88 ft.; 1 ft. 3 in. at 94 ft., Jewel?
No. 15.—129	5	„	No data.
No. 16.—140	0	„	Small thin seams.
No. 17.—133	8	„	Coal—1 ft. 3 in. at 74 ft.; 8 in. at 126 ft.
No. 18.— 70	0	„	Sandstone at 35 ft.

APPENDIX 6.

Saltwater Bores.

No. 1 Watson.

East of railway and 600 yards north of Deadman's Creek.

	Ft.	in.
Surface rock	18	0
Shales	14	0
Coal	0	3
Shale	16	3
Coal	0	6
Shale and ironstone	7	6
Sandstone	4	3
Shale	0	3
	61	0

No. 2 Watson.

South from No. 1.

	Ft.	in.
Surface	10	6
Shales	51	0
Sandstone	1	6
Shales	7	4
Ironstone	0	3
Dark shales	45	5
Ironstone	1	9
	117	9

No. 3 Watson.

On western side of railway line, south-east of Aldershot Works.

	Ft.	in.
Surface rock and clay	29	0
Shales	11	6
Coal crop (Jewel? Seam)	4	0
Shale „ „	1	9
Coal „ „	0	6
Shales	29	11
Fine sandstone	3	6
Shale	1	0
Sandstone	7	6
Shales with ironstone	22	0
Coaly shale	15	0
Sandstone	1	6
	123	6

No. 1 Archibald.

6 yards E. of Saltwater Creek.

	Ft.	in.
Surface rocks and clay	9	0
Shale	1	0
	10	0

No. 2 Archibald.

12 yards E. of Saltwater Creek.

	Ft.	in.
Surface	16	2
Shale	1	6
	17	8

No. 3 Archibald.

60 yards E. of Saltwater.

	Ft.	in.
Surface	14	0
Shale	10	8
	24	8

No. 4 Archibald.

100 yards E. of No. 1.

	Ft.	in.
Surface	17	4
Shale	8	6
	25	10

No. 5 Archibald.

200 yards S.E. of No. 1, and 8 yards E. of creek.

	Ft.	in.
Surface	12	0
Shale	1	0
	13	0

APPENDIX 6—*continued.*

Saltwater Bores—*continued.*

No. 6. Archibald.
250 yards S.W. of No. 1.

	Ft.	in.
Surface ...	11	0
Sandstone	10	10
Shale	4	0
Soft coal	0	8
Shale with coal veins	2	6
Shale	2	6
Sandstone	4	0
	35	6

No. 7 Archibald.
30 yards S. of No. 6.

Surface ...	18	6
Brown sandstone	2	6
Shale and clay	8	0
Sandstone and conglomerate	8	4
	25	4

No. 8 Archibald.
70 yards S. of No. 7.

Surface ...	11	6
Shale	2	4
Sandstone	2	6
Sandstone boulders	2	0
Shale	4	6
Greystone	2	4
Shale	5	0
Coal (Burrum ? Seam)	1	0
Band ,, ,,	0	2
Coal ,, ,,	1	3
Band ,, ,,	0	1
Coal ,, ,,	0	8
Greystone	2	0
	47	4

No. 9 Archibald.
30 yards S. of No. 8.

Surface ...	20	0
Shale	3	6
Sandstone	8	6
Shale	3	0
Coal (Burrum ? Seam)	1	3
Band ,, ,,	0	4
Coal ,, ,,	1	0
Greystone (coaly)	1	4
	38	11

No. 10 Archibald.
300 yards S. of No. 9.

	Ft.	in.
Surface ...	22	9
Coal	0	6
Greystone	14	4
Shale	10	0
Greystone	12	0
Shale	4	4
Coal (Jewel ? Seam)	2	1
Greybands ,, ,,	1	7
Coal ,, ,,	0	2
Shale ,, ,,	2	2
Coal ,, ,,	0	6
Shale ,, ,,	1	2
Coal ,, ,,	0	7
Shale ,, ,,	1	2
Coal ,, ,,	0	11
Shale ,, ,,	3	6
Coal ,, ,,	0	4
Shales ,, ,,	2	0
Ironstone ,, ,,	1	0
	81	1

No. 11 Archibald.
150 yards from Deadman's Creek.

Surface ...	8	4
Coal	0	1
Ironstone and clay	11	3
Blue shale	3	0
Sandstone	5	0
	27	8

No. 12 Archibald.
50 yards from Deadman's Creek.

Surface ...	3	0
Blue shale	2	2
Coal	0	7
Grey sandstone	5	2
Blue shale	1	8
Coal	0	8
Grey sandstone	4	8
Shale	2	3

No. 12 Archibald—*continued.*

	Ft.	in.
Coal	0	9
Shale	4	6
Coal	0	4
Band	0	1
Coal	0	6
Sandstone	3	6
Blue shale	1	1
Coal	0	9
Fireclay	1	8
Blue shale	0	8
Coal	1	9
Band	0	2
Coal	1	0
Greystone	1	8
Coal	0	9
Coaly greystone	2	2
Shale	4	2
Coal (Watson ? Seam)	1	8
Grey sandstone	6	4
Shales	16	3
Shales with coal	27	4
Shales	9	9
Coal	1	2
Fireclay	0	2
Coal	0	8
Grey sandstone	3	0
Shales	13	3
	93	11

No. 13 Archibald.
Over the Creek.

Surface ...	15	0
Grey sandstone	15	3
Shales	5	9
Coal	0	2
Shale	3	4
Coal (Watson ? Seam)	1	4
Shale ,, ,,	0	3
Coal ,, ,,	0	7
Sandstone	20	2
Shales	4	11
	66	9

APPENDIX 7.

Annual Outputs of Burrum Mines.

1883	6,440 tons, valued at		£3,780
1884	6,150	,, ,,	3,550
1885	26,914	,, ,,	14,950
1886	39,048	,, ,,	23,189
1887	45,527	,, ,,	25,609
1888	56,634	,, ,,	30,096
1889	48,267	,, ,,	25,916
1890	58,781	,, ,,	32,926
1891	42,516	,, ,,	24,003
1892	42,268	,, ,,	24,494
1893	54,075	,, ,,	31,347
1894	56,035	,, ,,	26,754
1895	75,299	,, ,,	36,139
1896	80,320	,, ,,	37,820
1897	77,301	,, ,,	38,691
1898	91,890	,, ,,	41,526
1899	111,414	,, ,,	40,597
1900	110,849	,, ,,	41,148

[No. 170 of the Geological Survey Publications.]

Price. 2s. 4d.]

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane.

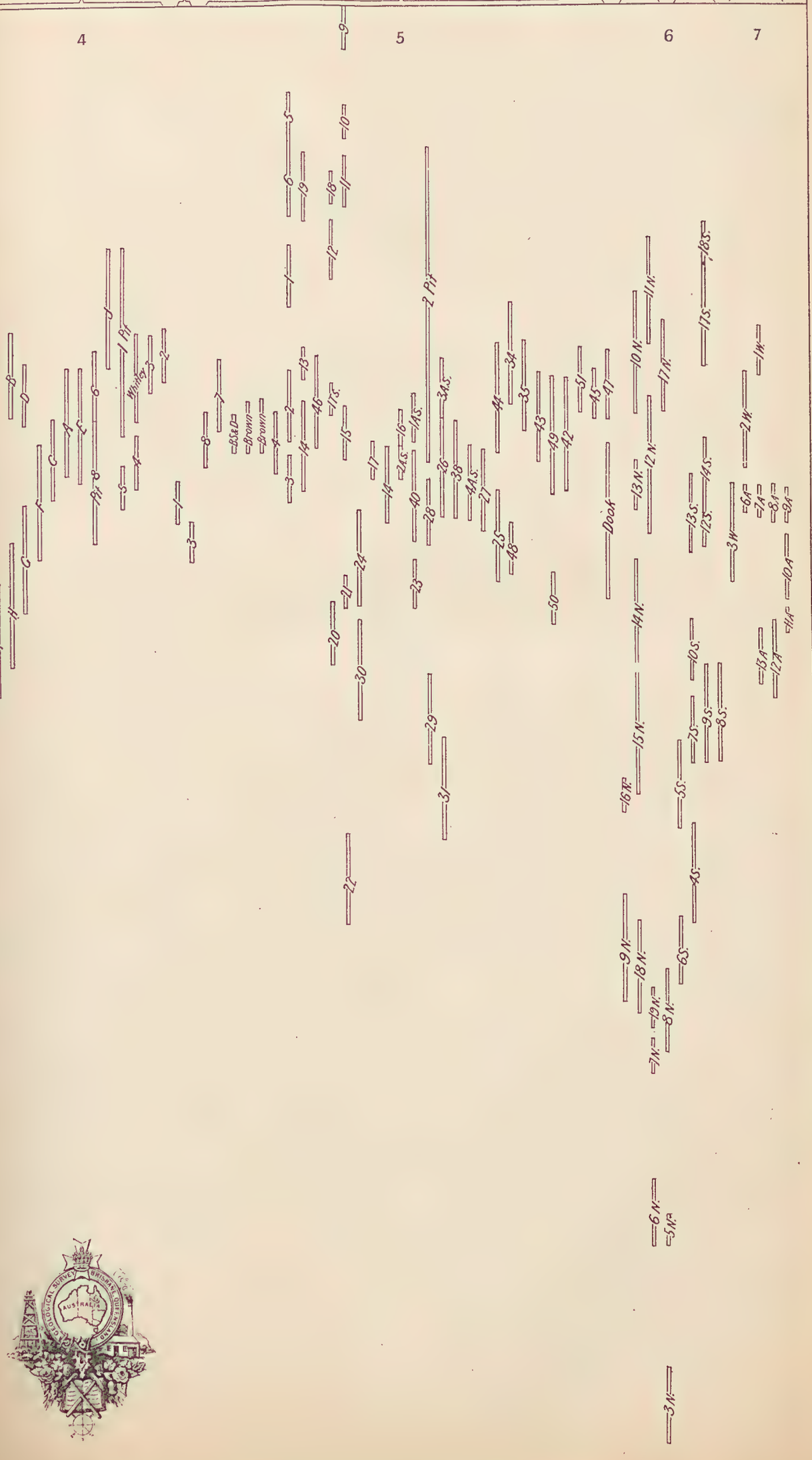
APPENDIX 2

Relative vertical positions of strata cut on all the bores given

N. W. S. E.

GOODWOOD HOWARD DUDLEY BURRUM & TORBANLEA COLTON N. COLTON S. SALTWATER

3 4 5 6 7



Scale (vertical only) = 169 feet to an Inch

To accompany Report on the Burrum Coal Field by Lionel C. Ball
Assistant Govt Geologist 1901

VICTORIA

PLAN OF
Land held by the
MARYBOROUGH-BURRUM COAL Co. LIMITED
Shewing position of Bores &tc.

Scale 30 Chains to an Inch

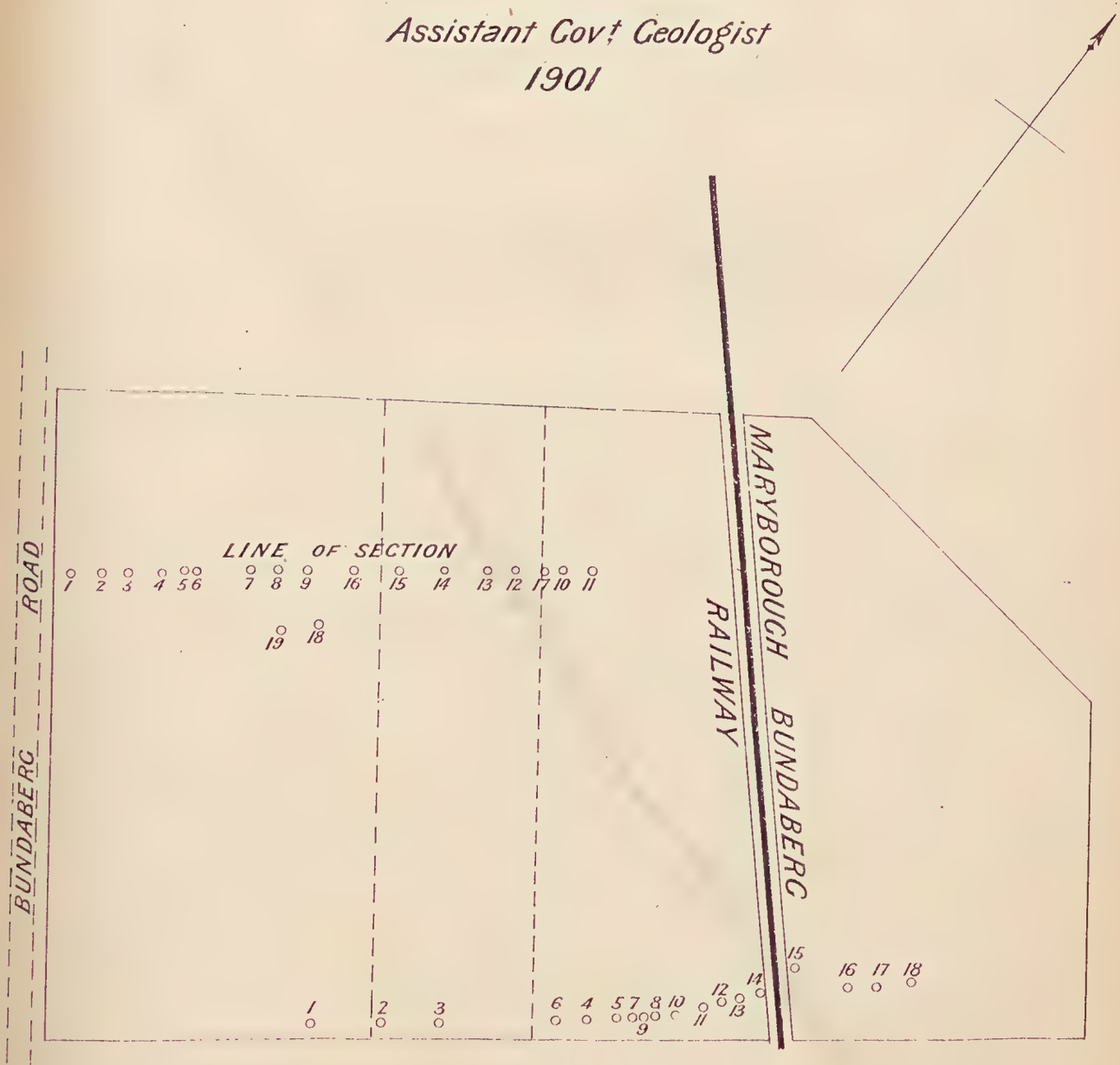
To accompany Report on the Burrum Coal Field

by

LIONEL C. BALL

Assistant Govt Geologist

1901



By Authority: GEORGE ARTHUR VAUGHAN, Acting Government Printer, William street, Brisbane.

PLAN OF
PORTION 223
PARISH OF MARYBOROUGH

Shewing position of Saltwater Bores

Scale 30 Chains to an Inch

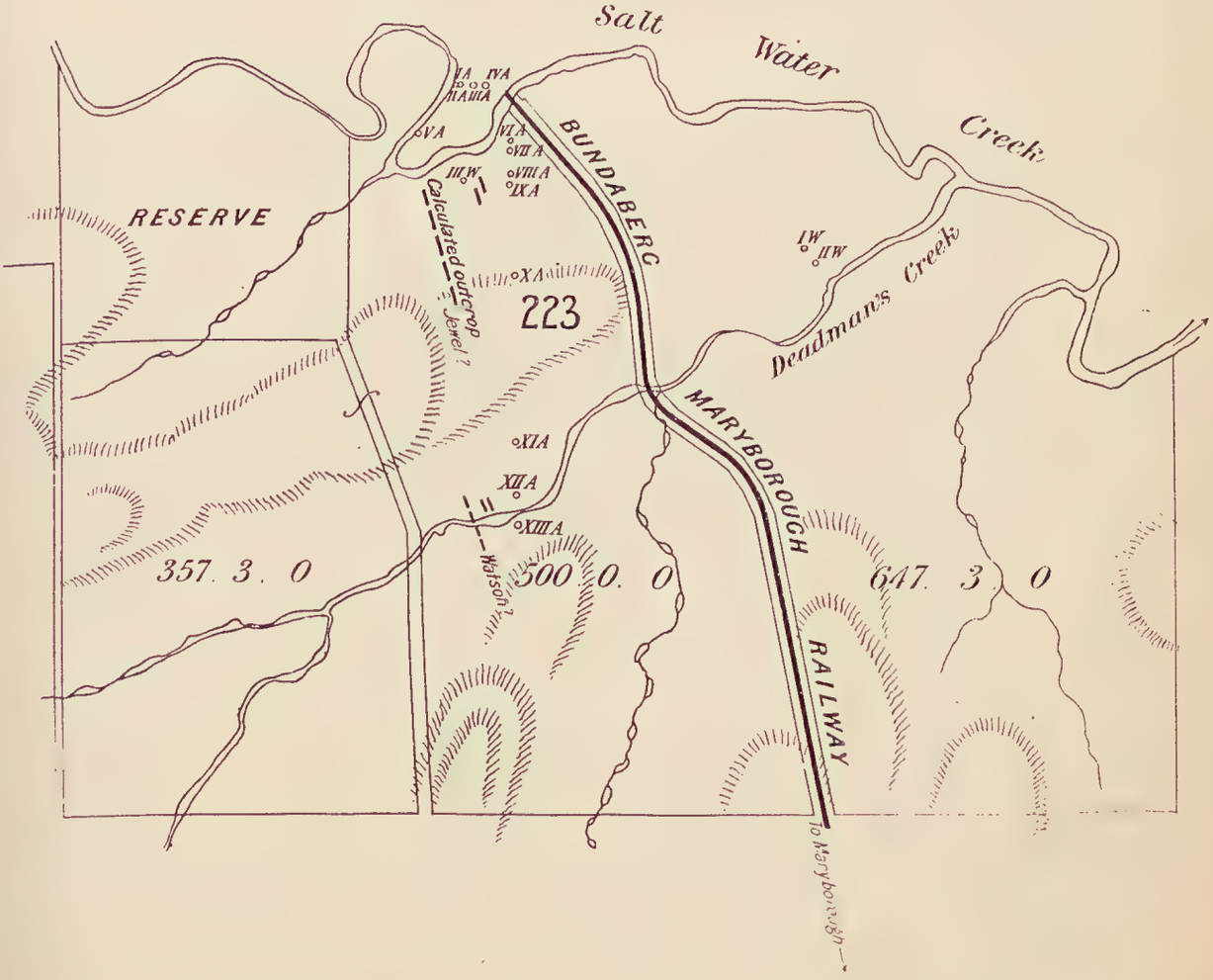
To accompany Report on the Burrum Coal Field

by

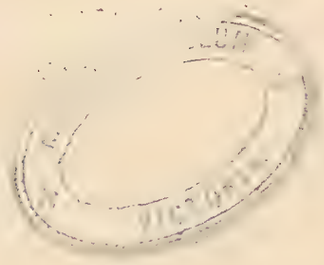
LIONEL C. BALL

Assistant Govt Geologist

1901



By Authority: GEORGE ARTHUR VAUGHAN, Acting Government Printer, William street, Brisbane.



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1902.

QUEENSLAND.

THE SAPPHIRE FIELDS OF ANAKIE.

(REPORT ON, BY B. DUNSTAN, F.G.S., ASSISTANT GOVERNMENT GEOLOGIST.)

[*With 2 Maps and 12 Plates.*]

LETTER OF TRANSMITTAL.

THE HONOURABLE THE MINISTER FOR MINES, BRISBANE.

Geological Survey Office,
Brisbane, 22nd January, 1902.

SIR,—I have the honour to forward herewith Report on the Sapphire Fields of Anakie, with two Maps and twelve Plates, by B. Dunstan, Assistant Government Geologist.

I have, &c.,

WILLIAM H. RANDS,
Government Geologist.

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   (*b*) Metamorphic rocks.
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1.—INTRODUCTION.

For several years past sapphires have been known to occur in a number of localities near the small railway station of Anakie in Central Queensland, and a report was written on the subject by Dr. R. L. Jack in 1892,* giving details of their occurrence and of the prospecting work carried on up to that time. Latterly considerable attention has been drawn to their value, and also to the large area of country over which they have been found, and to the extensive deposits within this area which have not been explored.

There has always been a tendency with those engaged in the mining of sapphires at Anakie to say as little as possible about the industry, as they were afraid public attention would be drawn to it. This attention they have been very careful to avoid as, so they say, miners would be attracted to the field and more gemstones would be obtained than a market could be found for, and a consequent depreciation in their value would result. Without expressing an opinion as to the wisdom of this policy, it might be stated that publicity would also have the effect of attracting the attention of buyers and dealers to the occurrence of the sapphires, and this might more than counterbalance the effect of greater production.

Taking into consideration the fact—and a fact that must be pointed out at the beginning—that there are peculiarities in colour in the Anakie sapphires by which they can be distinguished from foreign sapphires, greater publicity would no doubt tend to establish the stones as purely Australian productions, and would tend to give them a value uninfluenced by their comparison with those produced in other parts of the world.

Parcels of Anakie sapphires have been sent to English, American, and Continental dealers by miners on the field and also by others interested in the development of the industry, but while some of the dealers have become regular buyers of the stones, others do not look on them with favour. This peculiarity of colour, which is only in the blue shades, has militated against their sale, but a large proportion of the stones are of fine bright green and yellow shades, and when cut make very beautiful gems.

The hesitation which some dealers feel in buying Anakie stones is not altogether due to their colour, however, as in buying consignments of stones from the Anakie miners, the dealers are not made acquainted with the conditions which prevail on the sapphire fields, and they have no idea of the

* Report on the Sapphire Deposits and Gold and Silver Mines near Withersfield.—R.L.J. By Auth.: Brisb., 1892. (G.S.Q., 81.)

extent of the deposits from which the stones are obtained. In consequence of this lack of knowledge they do not know if a fair supply could be maintained, nor whether higher prices will have to be paid, should they, by any means in their power, create a greater demand for the sapphires.

Let it be known that the field is a large one, that the extent of sapphire wash is second to none in the world, and that a constant supply of stones could be maintained—facts which will be established in the following pages,—then there will be no cause for complaining that markets cannot be found for the stones. The greater demand for the sapphires will be met by a greater production, and with a greater production the dealers will not be contented to wait for consignments to be forwarded to them, but will themselves visit the field periodically, and buy direct from the miners, a condition of things satisfactory to all concerned.

An illustration may be given of the effects of reserving from the dealers and the public any information about the fields, and the hesitancy on the part of the dealers to state that any good stones they might want to dispose of came from an unknown locality such as Anakie, or on the part of the public in buying stones if they be told they came from such a place. The following extract was taken from a letter received by the writer from a representative of a Geneva firm of lapidaries and dealers. It states that "Fine sapphires, equal to those from Burma, have been found amongst the Australian gemstones. Most of these are sent to Germany by dealers, where they are sorted. The best gems are afterwards sold separately under another name, and the inferior lots sold as Australian."

In the following pages it is proposed to describe the various gemstones and other minerals found on the sapphire fields, to give an account of the geological features of the deposits containing the stones and the formations with which they are associated, the source from which the sapphires have been derived, methods of sapphire mining, some historical notes, a short account of the principal foreign sapphire deposits for purposes of comparison, and the occurrence of the first diamond recorded from Central Queensland.

2.—TOPOGRAPHICAL FEATURES.

The Anakie Railway Station is situated on the main Central Queensland Line, and is twenty-six miles west from Emerald and 192 miles west from Rockhampton. Its general position is indicated on the small plan attached to the large map. It is from Anakie as a centre of radius the sapphire fields extend both in a northerly and westerly direction.

The Drummond Range is the main watershed of the Anakie District, having the Zamia, Anakie, and other ranges branching off from it. From Bogantungan the Drummond Range extends northerly, while from a point a few miles north of this town the Zamia and some smaller ranges extend north-easterly. The Anakie Range trends more towards the east.

The most prominent landmark of the district is Mount Leura, a peak about 2,000 feet high. Although parts of the Anakie Range a few miles to the south and the Drummond Range away to the west are much higher, yet the surrounding country is comparatively low, and the mountain in consequence very conspicuous. Numerous other peaks are scattered over the country, and all are remarkable for their isolation from one another. They are, there is no doubt, remnants of a basaltic lava which once flowed over the granite now exposed at their base.

The whole of this area is drained by tributaries of the Nogoa River, of which Theresa Creek is the principal affluent. It is the smaller branches of Theresa Creek, however, such as Central, Tomahawk, Retreat, Argyle, and Sheep Station Creeks, about which most of the deposits of sapphire wash are to be found. Over most of the country drained by these creeks there is no difficulty in travelling, but some of it is very mountainous, while other low-lying portions are impenetrable from being covered with a dense brigalow scrub.

3.—GEOLOGICAL OUTLINES.

Granite, and its varieties, form the oldest and most extensive system of rock-masses in the district. This will be seen from the accompanying maps and sections. Gneisses, schists, and slates rest against the granites, and the gradual changes of these rocks from one to the other can be observed in places, and from which it is assumed that the granite is of metamorphic origin. No indications were noticed of the granite being intrusive,

The gneisses and schists are everywhere found to be in contact with the granite, sometimes forming masses surrounded by this rock, but usually as belts, with the granite on one side and slates on the other. The schists change imperceptibly into slates, and for this reason the boundary between the slates and the gneisses and schists is only approximately shown on the accompanying maps. In some localities slates rest directly on the granite without any appearance of gneiss or schists as intercellated rocks, but such occurrences are not frequent.

Intrusive rocks occur of two kinds—acidic and basic. The acidic rocks, consisting of pegmatite, felspar porphyry, and felsites, are in great abundance, and traverse the granites and gneisses in all directions. The basic rocks are hornblendic, and are either massive hornblende rock or else diorite. There are also outcrops of massive epidote rock and garnet rock in places, resulting probably from the alteration of limestones in contact with the granite.

A very conspicuous break exists between the granites, gneisses, schists, slates, and intrusive rocks, taken as a whole, and the next younger formation—the Drummond Beds. Shales, sandstones, and conglomerates make up the greater mass of this series, and they abut on the granite and some of the other rocks with a junction well defined in many places. From a distant view, these beds appear horizontal where they are not close to the granite, but where they come in contact, their dip is between 60° and 70°.

The rugged features of some of the mountains previously referred to are due to the prominence of the conglomerates of the Drummond Beds, whose outcrops are approximately parallel to the line of junction between the sedimentary series and the granite, although some distance away.

The series comprising the shales, sandstones, and conglomerates are placed as Drummond Beds, but they may belong to the "Star" Formation. No fossils have been found in them, neither was any detailed stratigraphical work carried out on them.

After the deposition of the sediments to form the Drummond Beds, of probably Permo-Carboniferous Age, there was a long interval during which either no material accumulated at all, or else it has being washed away without leaving behind any traces of its former presence.

There are no representatives of any of the Mesozoic Formations to be found *in situ* either above the Drummond Beds or on the granite or slates, and although the remnants of a formation later than the Drummond Beds are to be found as boulders in Tertiary and Recent Alluvial Deposits, otherwise all evidence of the existence of Mesozoic Rocks have been destroyed.

These remnants of a pre-existing formation consist of boulders of a hard flinty quartzite, so peculiar in their being found as a surface formation and so general in their occurrence in Central Queensland, that they have been designated as "billy," a local name given to them by the alluvial gold miners of Clermont.

This "billy" has usually and, perhaps, arbitrarily been placed as of "Desert Sandstone" Age, and without going into the question of whether this view is right or wrong it will be provisionally placed here as such. It occurs exclusively as boulders in the alluvial sapphire deposits, and from its abundance and distribution probably has been derived from what must have been a very extensive formation.

One remarkable feature in the occurrence of the "billy" is its being limited to sapphire deposits formed below the junction of the Drummond Beds and the granite. The country in which all the creeks have their source is composed of these sedimentary beds, while the country lower down is all granite. In an examination of the debris in the channels of the present and the pre-existing streams, this feature in the occurrence of the "billy" is to be noticed.

Basalt is found in a great number of places, but there are no extensive flows of it existing at the present time. A large area of it must have once existed, but denudation has removed almost all of it, leaving only a capping on the tops of the hills and mountains.

The sapphire deposits are distributed over a large area, but nearly all are confined to the granite country. The deposits occur on the banks of the creeks, but very rarely are they found in the beds of the present streams. Generally they are high above the beds of the creek, on the sides or base of the low hills; nevertheless, they are found to be roughly parallel with the creeks in most places.

There is a difference of about 500 feet between the altitude of the deposits on the eastern or lower portion of the district and those on the western or mountainous region towards the source of all the creeks; but sapphires were found in the basalt, at an altitude of 500 feet above the highest alluvial deposit.

The recent *débris* of the creeks do not carry sapphires, or, rather, none have been found in them. The sapphires do not travel very far, and if the deposits which contain them on the sides of the ridges have been washed away, the sapphires will still be found just below the remaining portion of it in the gullies, perhaps only a short distance away.

Map 1 is a geological sketch of the whole of the district examined, and is on a scale of one mile to the inch. It embraces an area of about 400 square miles, of which fifty square miles contain deposits carrying sapphires of more or less value.

Altitudes have been taken of the more important places, and show the high position of some of the deposits of sapphire wash to the west of the area when compared to the lower ones to the east. In the topography of the country some new features are added, as the old maps on which the work was based are incomplete in many respects.

Geological boundaries for the most part are only approximately shown, as the work was directed more towards the occurrence of the sapphires than to the details of the geological formations.

Map 2 is on a larger scale, and shows in greater detail the position of the sapphire deposits of Retreat Creek, Policeman Creek, Iguana Flat, and Sheep Station Creek, together with other geological and topographical information.

4.—GEOLOGICAL FORMATIONS.

(*a*) Granite Rocks.

It will be observed on perusing the accompanying map (1) that on the northern side of the district granitic rocks form a large area. The rocks are mostly syenite, with intrusive dykes of red felspar porphyry, the surface of which in places is very much decomposed. In the small rivulets abundance of magnetite is to be seen.

This part of the country is the watershed dividing Tomahawk and Serpentine Creeks, trending north-east, from Carbine, Cattle, and other creeks trending easterly. Syenite occurs on the Clermont-Anakie Road, from Cattle Creek on the north, down to the foot of Mount Leura, and both to the east and west of the road in numerous localities syenite and granite outcrop on the surface. The granite rocks pass south of Mount Leura as far as Retreat Creek, and westerly as far as shown on the map.

Syenites, with similar porphyry dykes, occur on Sheep Station Creek, and granite outcrops occur along Iguana Flat. Some of the outcrops of granite in the gullies of Iguana Flat leading down to Sheep Station Creek are a coarse-grained muscovite granite. Other similar occurrences are to be seen in the neighbourhood of the junction of Retreat and Spring Creeks.

In the whole of the granite area no indications were seen of auriferous reefs or any deposits of other minerals of commercial value, except near or at the contact of the granite with the metamorphic rocks or with the slates or diorite intrusion.

It has repeatedly been asserted that stream-tin occurs in some of the watercourses where the granite is decomposed. All the black sand examined, however—and some of it, it may be stated, came from Mount Ball, where at one time prospecting for tin was in operation—proves the absence of this mineral. The presence of black tourmaline in abundance, and also titanic iron, pleonaste, and magnetite may indicate how the mistake arose in supposing stream-tin to occur here.

There has been a tendency with some miners to compare this field with the tinfields of New England in New South Wales, because at Anakie there are most, if not all, of the minerals to be found which in New England are associated with stream-tin. Stream-tin, of course, might be found here, but the opinion may be expressed that the possibilities are very remote.

Pegmatite granite occurs in a great number of localities within the granite area. A section of a specimen from Mount Leura shows tourmaline as idiomorphic crystals in quartz and felspar (Plate 3, Fig 6). It occurs as dyke masses in the finer-grained granite.

(*b*) Metamorphic Rocks.

The area over which the metamorphic rocks are exposed is much more limited than that of the granite. They occur as well-defined belts, sometimes in contact with the granite and sometimes with the slates. One of these belts, starting from Mount Bullock on the north side of Retreat Creek, extends northerly across Policeman Creek. Another belt extends from the eastern side of Iguana Flat and crosses Retreat Creek and Spring Creek in a southerly direction. It is on a portion of this belt that the Withersfield Sapphire Company has its freehold property. Another smaller outcrop exists near the Mount Clifford Mine, and spreads across Ruby Creek to the east of the old alluvial gold workings, known as Basalt Hill Diggings. An outcrop also occurs at the sapphire mines of Mr. Hunt. (*See* Map 2.)

Portions of these metamorphic belts are auriferous, and several lodes are known to occur in them, but nothing of importance has yet been developed. Gold has been found in the gullies at the base of Mount Bullock, and very probably has been shed from the outcrops of quartz reefs in the vicinity. At Sheep Station Creek there is a small outcrop of a fine-grained hornblende schist, sections of which show it to be hornblende, quartz, and red garnet.

(*c*) Slates.

The development of slate formation, so far as concerns the area shown on the accompanying map, is confined to the portion on the eastern side, but there is evidence, however, of its continuation much further north and north-east. The slates are argillaceous, talcose, micaceous, and occasionally quartzose.

At Mount Pleasant, between Ruby and May Creeks, the rocks consist of siliceous and clay slates, the beds being vertical and having a north and south strike. The slates from here trend northerly to the workings of the Mount Clifford Mine, where they have been disturbed by diorite intrusions.

To the north of Policeman Creek, about nine miles north of the Anakie Railway Station, ironstone "blows" are very common in slate formation. They consist of clayey limonite and hematite and usually contain gold, but the small amount of prospecting work done on them has not revealed anything payable. These ironstone lodes or "blows" are certainly worth further attention, but the gold will probably be very fine and coated, and consequently, even if payable, its presence will not be easily detected. Copper lodes have been worked in the slate formation, and possibly copper once existed in the ironstone exposed, but which has since been removed by surface waters. Below the surface some of the ironstone has proved to contain copper as well as gold, but all mining operations in the district are in the development stage.

At Mount Clifford, which is about half-a-mile north-west of Mount Pleasant, work has been in progress intermittently for some years back. Both gold and copper has been found in a formation between outcrops of diorite and slate, and although a considerable amount of prospecting work has been carried out and machinery erected for treating the stone, so far all the work has not produced any tangible results.

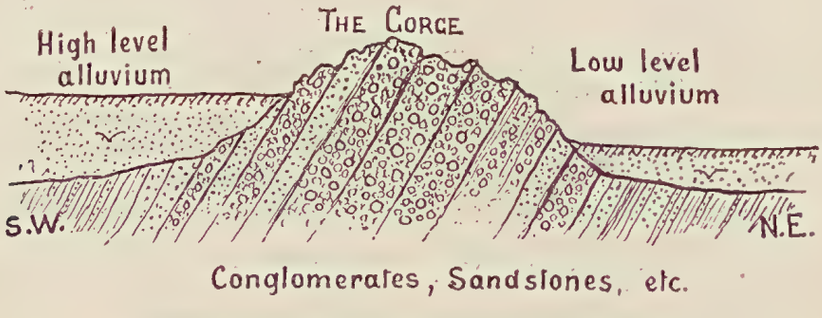
(*d*) Drummond Beds.

This formation, which was only given cursory attention, is separated from the granite by a north-west and south-east line of junction. At the westerly portion of the Anakie Range shown on the map, there seems to be a south-eastern terminus of a disturbed zone in which all the rocks have been tilted against the granite, and where the sandstones and conglomerates have withstood weathering action better than some shale beds below them. The sandstones and conglomerates, more especially the latter, have become prominent features on the north-westerly extensions from the Anakie Range, while the shales below form the depressions in the landscape features to the north-east of them, as shown in the section on Plate 12.

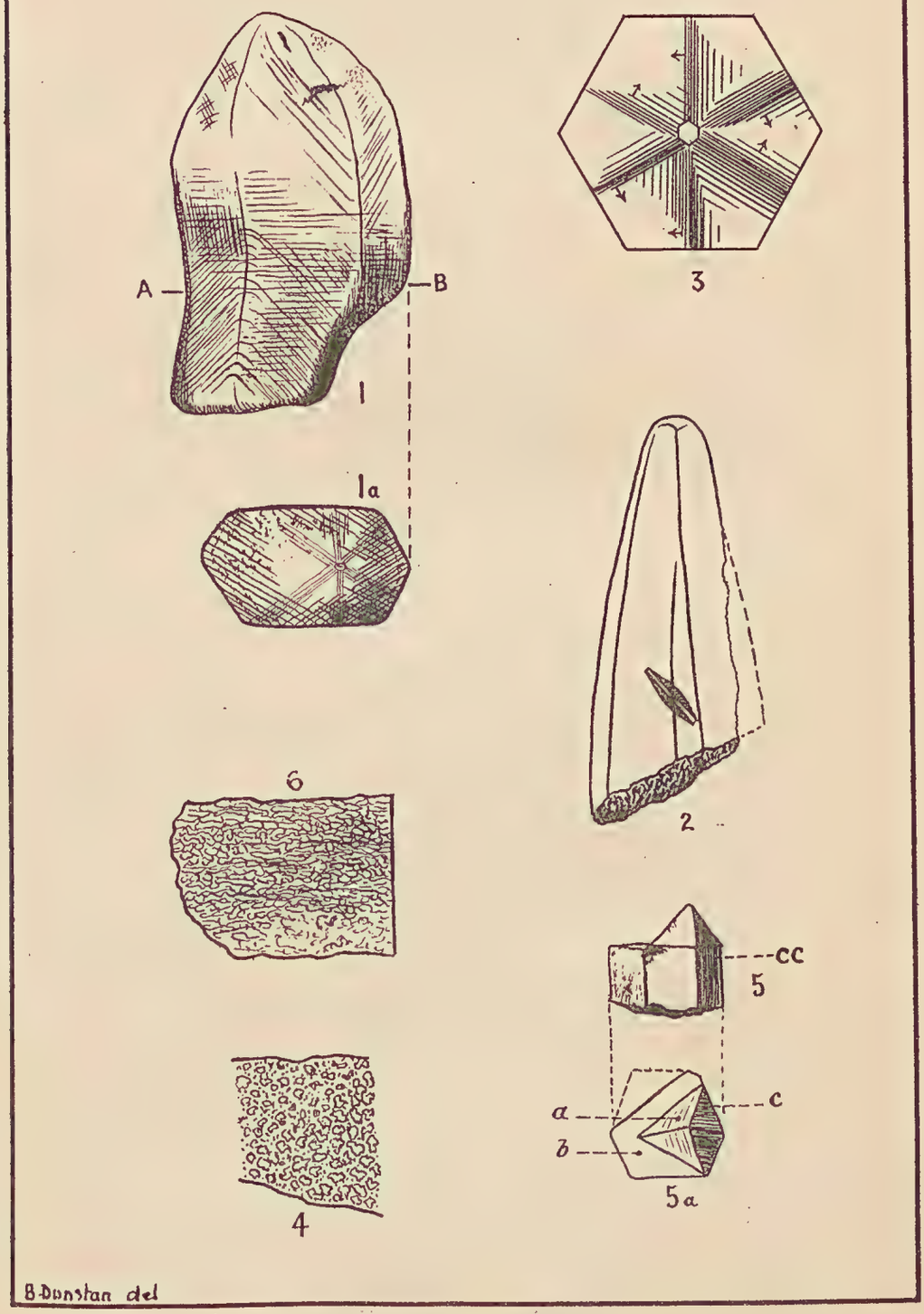
On Tomahawk Creek, south-east of Mount Hoy, the bed of the stream is very much confined between precipitous walls, and is known as the "Gorge." Here the highly inclined conglomerates are exposed in some fine sections, and show unmistakably their interstratification with the sandstones. Some doubt was felt as to what formation to assign the conglomerates to, whether they should be regarded as a portion of the Drummond Beds, or if they belonged to the "Desert Sandstone," but the observation cleared up all doubts on the matter. Other somewhat similar sections were seen subsequently.

The following sketch (Fig. 1) represents a section of the belt of conglomerates and sandstones where Tomahawk Creek has broken through it, and shows the bank along the creek at one part of the gorge.

Fig. 1.



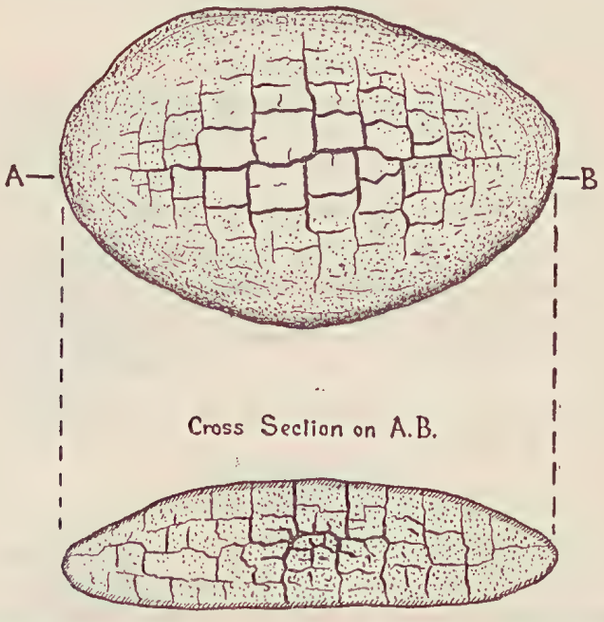
Section at the "Gorge" at Tomahawk Creek.



Corundum Crystals

The shales on the north-easterly side of the conglomerates contain abundance of septarian nodules, some of which are over a foot in diameter, but usually much less. From their shape and the markings on their surfaces they have been called "fossil turtles." Fig. 2 shows the surface markings and a section through the middle of one of them.

Fig. 2.



Septarian nodule ("Fossil Turtle") from Ten-mile Gully, south-east of Mount Hoy.

In places small nodules of less than one inch in diameter are imbedded in an argillaceous limestone, of which microscopic sections show a well-marked septarian structure.

Regarding the steep inclination of the strata belonging to the Drummond Beds, Dr. Jack has observed that "at Bogantungan is an axis of a synclinal trough, and that as far eastward as Withersfield the dip is towards the west."* With this the writer's observation agrees, and would further show that at the edge of this basin or trough, where the formation is in contact with the granite, the beds have been much disturbed. The conglomerate belt, which is such a conspicuous feature in the western portion of the sapphire fields, does not seem to have come under previous observation in the district, so probably is of local development.

It has been previously stated that the slates, schists, gneiss, and granite may be looked upon as one series in which the lower beds have become granite by metamorphic change. It does not follow from the tilting of the conglomerates and the other beds, where they are in contact with the granite, that a movement of the granite has taken place subsequent to the deposition of the sedimentary beds. It may be due to a depression taking place in the sedimentary beds as much as to the elevation of the granite. These beds have been intruded by rhyolites, a reference to which will be made further on.

(*e*) Diorites.

At Mount Clifford some mining operations are closely associated with the diorite, details of which were published three years ago.†

Referring to the diorite therein, it is stated that—"The slates are intruded by diorite, which forms conspicuous masses where it crops out on the surface, and the reefs of the Mount Clifford Mine, and others in the locality, are formed at or near the junction of the slates and schists with this igneous rock. There seems to be two intrusions of this diorite. One of the diorites, however, is more decomposed than the other, and the texture is somewhat different, as well also as the state of aggregation of the minerals composing them. The reefs which come in contact with the more decomposed diorite are said to be quite barren, while those in contact with the less decomposed diorite are found to be auriferous. By the miners the former is called the old diorite, while the latter is referred to as the new."

Thin sections of these were examined, from which it was observed that—"The diorite adjoining the barren reefs proves to be a rock containing a large proportion of partly kaolinised felspar (the grey mineral seen in hand specimens), and to this is due its weathered appearance. The hornblende (the black mineral) is very fresh in places, and only a small portion of it is decomposed. The characteristic cleavage is very marked, and pleochroism is to be observed in places under polarised light. Magnetite occurs in rather coarse grains, and iron pyrites is found sparingly in the section. In the diorite in contact with the auriferous reefs and "deposits" the felspar is much clearer than in the one just described, and under crossed nicols multiple twinning is shown quite distinctly. The hornblende is nearly all decomposed, and faint pleochroism is only seen in very small patches of the mineral remaining unaltered. Magnetite occurs disseminated throughout the green chloritic decomposition product of the hornblende, and pyrites is present in some abundance."

On the south side of Retreat Creek, between Spring and Ruby Creeks, and close to the Poverty Hill sapphire workings, a low outcrop of diorite is exposed, while further down Retreat Creek in the

* Report on Sapphire Deposits and Gold and Silver Mines near Withersfield.—R.L.J. By Auth. : Brisb., 1882. (G.S.Q., 81.)
† Mount Clifford and other Mines near Anakie, Central Queensland.—B.D. By Auth. : Brisb., 1898. (G.S.Q., 127.)

deposits of sapphire wash, pebbles of a very similar rock also occur. The presence of the rock *in situ* at Poverty Hill is suggestive of a possible origin for the diorite pebbles in the wash, and also indicates the direction from which the material forming the sapphire deposits has come.

A coarse-grained diorite is exposed on the old Aramac Road, above Reid's Waterholes, the lagoons on Sheep Station Creek. The outcrop is a small one, but conspicuous because of its angular weathered surfaces. Macroscopically the rock is very coarse-grained, has a dark bluish-green colour, and contains large porphyritic crystals of hornblende, this mineral in fact forming the main mass of the rock in some parts of the outcrop. Microscopically, thin sections show the hornblende to be pale-green, and associated with irregular patches of magnetite.

(*f*) Rhyolite.

Masses of this rock are exposed near the junction of Argyle and Retreat Creeks. One of the outcrops is on the north side of Retreat Creek, and is the terminal point of a range extending south-east from Mount Hoy, while about a mile away on the south side of Argyle Creek there is another outcrop.

It was observed that in the sapphire deposits, and in the recent alluvium east from these rhyolite hills, there were pieces of chalcedony, somewhat like shells in form, but evidently pseudomorphs after lithophyses, the hollow spherulites. Sometimes they have two convex sides with radiating costæ, but frequently have as many as six sides. In ascending Retreat Creek it was noticed that the pseudomorphs were absent from the river *débris* above the rhyolite outcrops, and their source, on being looked for, was discovered in these outcrops. The lithophyses when taken out of the surrounding rock are like marbles in shape and size, the interiors of which are either lined or filled with chalcedony. In weathering, the lithophyses crumble away, leaving intact the pseudomorphs, which ultimately find their way down the watercourses.

The rhyolites are close to the junction of granite and the Drummond Beds, but they appear to be surrounded by the latter on all sides.

(*g*) Billy.

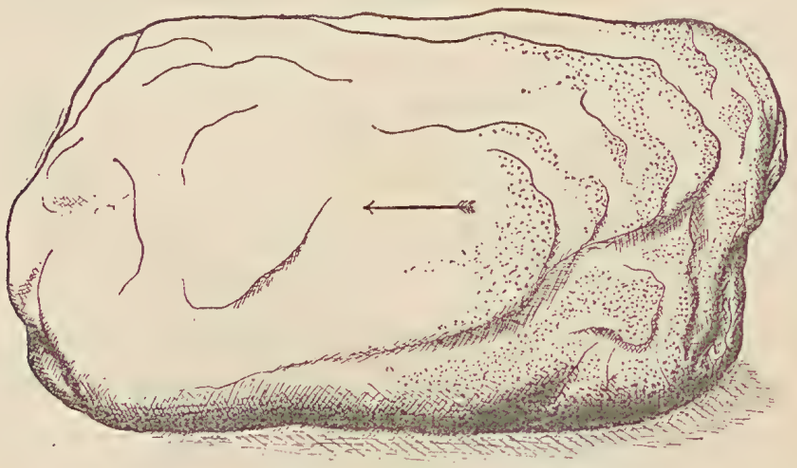
The term "billy" refers to a quartzite rock which has been formed probably from the surface silicification of sandstones. It has been referred to in previous Reports.*

The occurrence of this quartzite rock is very general in all the eastern parts of the field where sapphires are found. At Retreat Creek, Sheep Station Creek, and Policeman Creek, the rock is invariably associated with the sapphire deposits, and is not found any distance away from them. "Billy" is commonly known amongst the Anakie miners as "sapphire boulders," and where found in unprospected localities is always looked upon as an indication that sapphires probably exist close by. Therefore, where these boulders are met with they are usually turned over and an inspection made of the soil beneath and around them. On the abovementioned creeks the "billy" is found with other boulders of diorite, basalt, and quartz, the latter sometimes being in blocks over a foot in diameter.

On the Withersfield Sapphire Company's Reward Claim on Sheep Station Creek (*see* Map 2) the sapphire wash has been almost completely hidden by boulders of "billy," some blocks of which weigh several tons. An examination of these large blocks shows that they have not been shifted along the old channel in which they and the sapphires have been deposited, although possibly they formed a bed a few feet higher than their present level. It was also observed that the largest blocks retain the horizontal position in which they were deposited as a bed, and peculiarities in the grain of the stone indicate the close relation of the blocks to one another.

In appearance the blocks seem to have been water-worn, but this effect has not been produced altogether by the action of water. The first stage in the breaking up of the beds has been the production of fractures to often form angular blocks. The next stage would be the rounding of the corners of blocks by atmospheric weathering, as other rock masses are rounded. The third stage is the polishing of these surfaces by the action of water carrying very little suspended matter as abrading material. The final stage is the undercutting of the boulders by strong currents of water, carrying both coarse and fine material in suspension to destroy the fine polished surfaces on the boulders where they have faced the impact of the material coming down the stream. It is under such conditions the "billy" boulders have been formed, and the sapphires deposited amidst them. Fig. 3 represents one of them.

Fig. 3.



Boulder of "Billy," W.S.S. Reward Claim.

The arrow indicates the direction of flow of water carrying sapphire-bearing material. Dotted portions in the sketch indicate the roughened surfaces produced by the impact of the sapphire bearing material.

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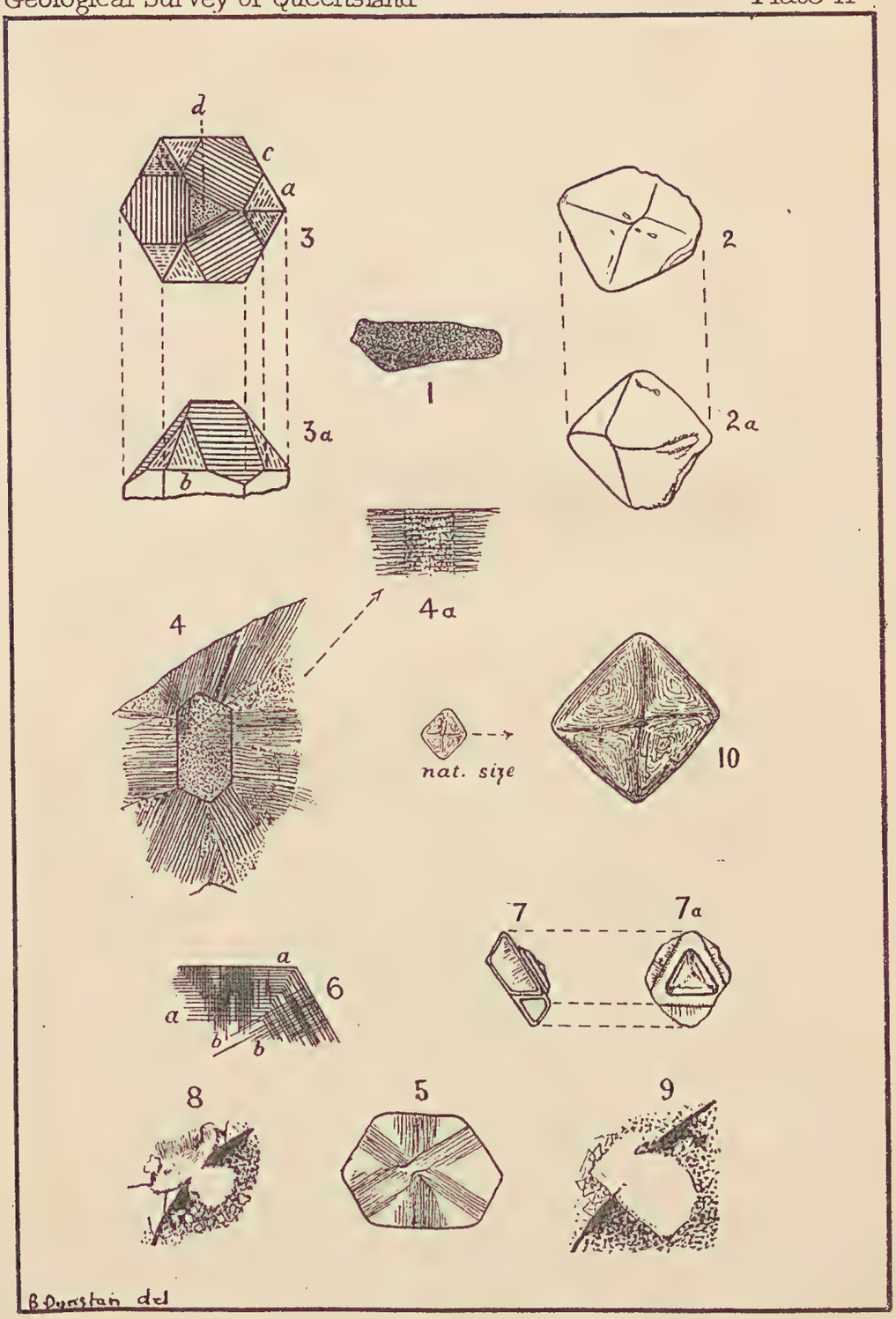
*1. Geology of the Dawson and Mackenzie Rivers, by B.D. By Auth.: Brisb., 1901 (G.S.Q. 155) p. 20.

2. The Permo-Carboniferous Coal Measures and Associated Formations, by B.D. By Auth.: Brisb., 1900 (G.S.Q. 148), pp. 5, 6.



Corundum, Pleonaste, Diamond.
&c.

The creeks north-westerly from Mount Leura—*i.e.*, Serpentine, Koski, Tomahawk, and Central Creeks—are remarkable for the rarity of "billy" in the sapphire deposits close to them. At Retreat Creek, near its junction with Argyle Creek, the rock is common in the river shingle and in the sapphire wash there, but on the other side of the Aramac Range, a few miles to the north-west on the above-mentioned creeks, it is not to be found. This rather shows that the "billy" and its varieties (ironstone billy, white billy, puddingstone billy, and billy conglomerate) are not the rocks from which the sapphires originally came, which, it may be stated, is a view contrary to that of the miners on the field.

Further on it will be shown how the deposits which now contain these boulders mixed with the sapphires came to occupy their elevated positions on the ridges and spurs.

If it be taken for granted that the "billy" has been formed at or near the place where it occurs in large boulders, it would follow that it once covered a portion of the country where now only granite, syenite, and metamorphic rocks are exposed, and because in this area it is confined to portions where sapphires occur, it should also follow that it was not spread over the surface of the country, but was confined to the channels of the old watercourses.

In travelling by road from Clermont to Anakie, billy was observed at intervals all along the route. At Clermont the billy is associated with gold in the alluvial deposits, while between Clermont and Anakie it contains both gold and sapphires. In consequence of this, a difficulty is felt in determining, outside the Anakie Fields, whether this rock is an indication of gold or of sapphires.

Microscopic sections show that small pebbles of sandstone in the billy have been completely altered, and sometimes difficult to distinguish from the surrounding finer material. The quartz grains in the pebbles show a second growth on the portions which have been abraded by water, and where the grains have appeared on the outer part of the pebble they have grown out from the pebble into the surrounding material. Plate II., Fig. 8 and 9, show this structure.

(*h*) Basalt.

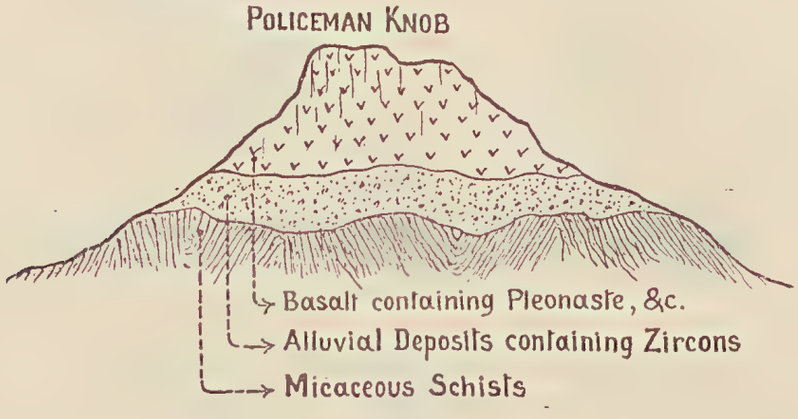
In the district very little remains of what must have been an extensive flow of basalt, and very little of this can be availed of from which to obtain information. At the same time, a number of features have been noticed in several places having an important bearing on the occurrence of the sapphires.

Probably one of the oldest alluvial deposits in the district is that at the Basalt Hill Diggings, about three miles north of the Borilla Railway Station (*see* Map 1), and this is covered by basalt. Several shafts have been sunk through this rock to test the alluvial deposits below it for gold, and, as well as obtaining gold, several other minerals have been found. These include garnets, zircons, magnetite, and tourmaline, but sapphires were not seen.

Pleonaste and olivine are also absent from the alluvial deposit, but are present in the covering of basalt, and in the soil derived from the decomposition of the basalt on the surface.

Policeman Knob is close to the southern bank of Policeman Creek (*see* Map 2), and is remarkable for the number of white and coloured zircons found in the old alluvial deposit underlying the basalt in some of the gullies leading down from the Knob. (*See* Fig. 4.)

Fig. 4.



A Basalt Covering an Old Drift.

The drift contains abundance of small white zircons, but from which sapphires are absent.

Inquiries were made concerning the presence of sapphire with the zircons, but none of the miners have heard of any being found, neither did a recent investigation reveal their presence. Pleonaste, olivine, quartz and other obscure minerals occur embedded in the basalt of Policeman Knob.

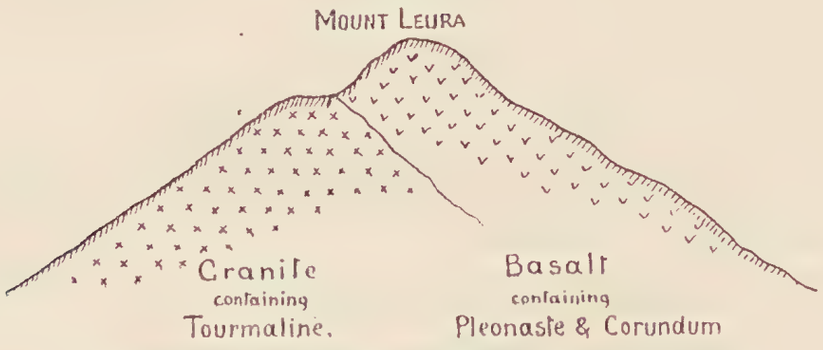
The presence of zircons and the absence of sapphires in alluvial deposits covered by basalt may be taken as an indication that the sapphires where they are found in other places have been deposited at a time later than that at which the basalt flow took place.

At Retreat, Policeman, and Sheep Station Creeks, boulders of basalt invariably occur with the sapphires, and pebbles of the rock are frequently found in which pleonaste is embedded. On Tomahawk Creek and other creeks in the western portion of the district basalt boulders also are present in the sapphire wash, but, as stated before, almost always without the "billy."

The basalt peaks are scattered all over the district, the three highest being Mount Leura, Mount Hoy, and Black Peak. Mount Leura is about 2,000 feet above sea-level and Mount Hoy about 1,860 feet. The altitude of Black Peak was not determined, but it is, nevertheless, much higher than Mount Leura. At all these mountains the older rocks can be distinguished at the base of the basalt, those

at Mount Hoy and Black Peak being Drummond Beds, and that at Mount Leura being granite. At Mount Leura the granite can be traced close to the top on one side, while on the other side the granite is not exposed at all. This is shown in Fig. 5.

Fig. 5.



The Contact of Granite and Basalt on Mount Leura.

The heights of the basalt peaks are less than that of the Drummond Range away to the west of them, but it cannot be stated if there are also volcanic peaks in that direction. There is evidence, however, that there is a general easterly decline in the height of the basalt as the distance from the Drummond Range becomes greater, so that in this direction, and perhaps also in other directions, flows of lava probably took place, and were connected with the extensive basalt areas at Tarabora, in the direction of Emerald.

The three peaks mentioned may be volcanic cones, but their peculiar shape, resulting from the splitting up of the basalt into vertical columns, cannot be taken as a guide in the matter. On the top of all of them the basalt has this columnar structure more or less developed, a feature particularly striking at Mount Hoy, where the basalt stands up in long parallel columns on the sides of the mountain.

This columnar structure is not, of course, confined to the craters or cones of volcanoes, as it occurs also in flows away from the vent, so that, from the presence of this structure, it must not be assumed that Mount Leura and the other peaks are volcanic cones. At the same time the probability of their being such is suggested from their elevated position.

Further evidence on the relation they bear to one another is supplied by their similarity in mineral composition. Their texture varies somewhat, a feature which may be due to conditions under which they solidified, and all of them are more or less magnetic. Taking a compass bearing on Mount Leura, Mount Hoy, or Mount Newsome is quite useless as the polarity of the large blocks of basalt causes the needle to deviate in all directions.

The mineral inclusions in the basalt on the tops of the mountains present many interesting features and throw some light on the origin of the sapphires. In examining Mount Hoy it was discovered that the mineral pleonaste is a very common inclusion in the basalt, but not occurring in forms which suggest crystallisation during the consolidation of the molten basalt. If the crystals have formed in the basalt, the corrosion which they have been subjected to would indicate the magma to have been molten subsequent to their formation.

A pale blue sapphire having a thick, black scaly coating on one side, together with abundance of pleonaste, was picked up on the summit of Mount Hoy. The sapphire was found at a height of 500 feet above the highest of the sapphire alluvial deposits, and although there are means by which it could have been taken up to the top from the deposits below, yet it very probably was weathered out of the basalt together with all the pleonaste with which it was found.

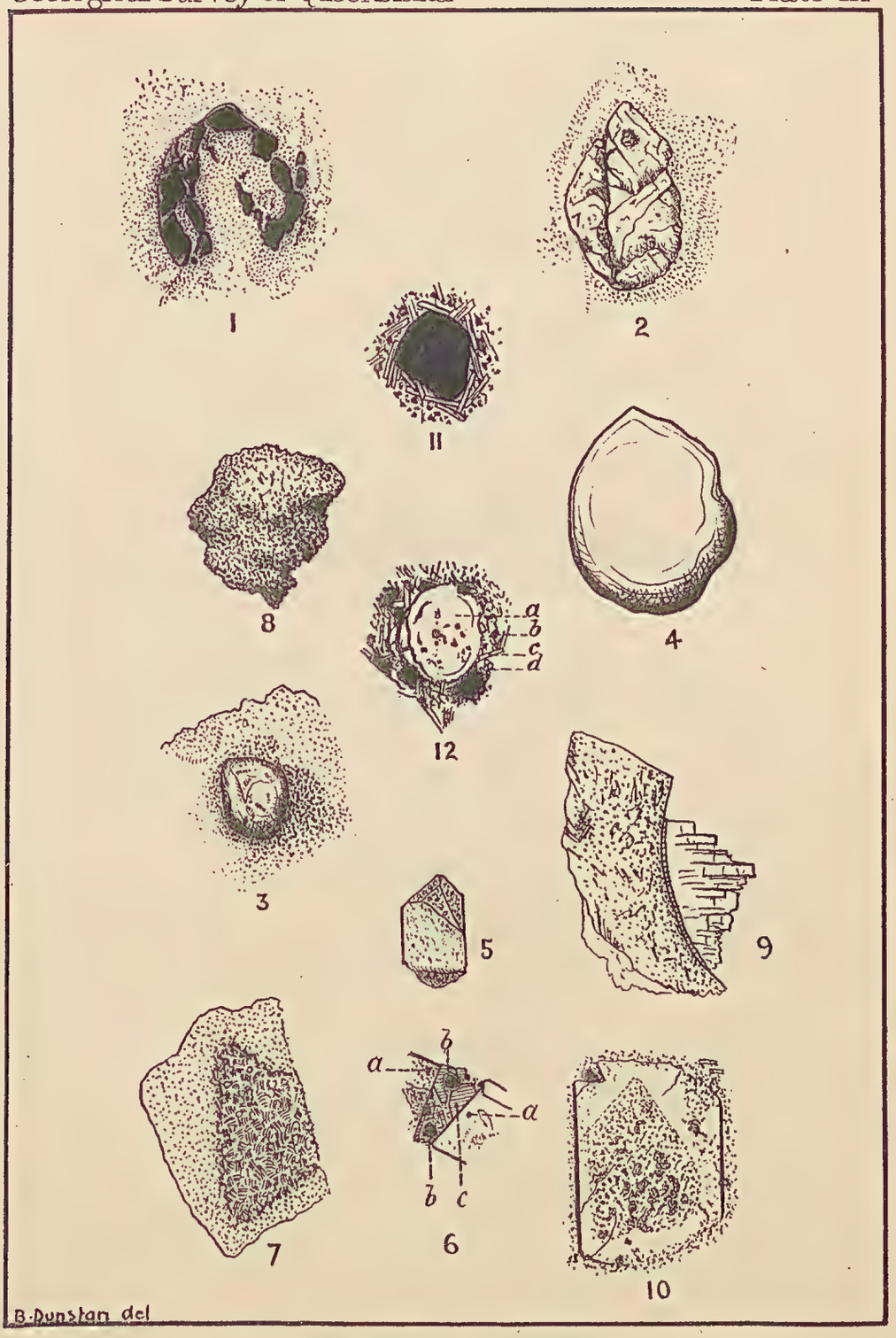
At Mount Leura a piece of bronze-black corundum was discovered partly exposed on a large face of basalt. Unfortunately there were no means available at the time by which the basalt around the corundum could be removed to show the one embedded in the other. This was the only specimen of corundum observed *in situ*. Inquiries afterwards from miners and others confirmed the discovery of the presence of this corundum in basalt, which commonly is known as "bronze pleonaste." A small parcel of stones brought by a prospector from the summit of Black Peak, about four miles south of Mount Hoy, on examination proved to contain pleonaste, titanic iron, hornblende, and two small angular fragments of corundum.

If, then, the basalt carries sapphires as inclusions, and if the basalt of those peaks once extended towards the east and north-east, then a part of the country at one time must have been covered by basalt containing sapphires, and which since then has been decomposed and washed away. The sapphires and other inclusions remaining undecomposed would lie in the watercourses on the surface of the rocks over which the basalt once existed.

What happened in the early stages in the history of the sapphire is purely speculative. Possibly the basalt has disturbed some of the metamorphic or granitoid rocks at a depth from the surface containing sapphires, and in being erupted has caught up portions of these rocks, and with them the sapphires. What is perhaps a more likely view is that the rock containing the sapphires has become molten, has altered its mineral, although perhaps not its chemical, composition, and has been ejected as a volcanic lava.

At Mount Leura, as well as the sapphire and pleonaste, other inclusions found in the basalt were hornblende, plagioclase felspar, titanic iron, quartz, and olivine, all of which show the effects of corrosion. A number of sketches of sapphires and pleonaste illustrating the effects of the corrosion by the basalt, is shown on Plates 1, 2, and 3.

Microscopic sections of the basalts indicate the Mount Leura and Mount Hoy rocks to be almost identical in every respect, but that they vary from the Mount Newsome lava in being of a fine texture. In Mount Leura and Mount Hoy sections the most conspicuous minerals are olivine and augite. In both the large and small crystals of augite the borders are corroded, while in addition the large crystals are frequently broken. Pl. 3, Fig. 10, shows a corroded crystal of augite. Olivine is sometimes well



Inclusions in Basalt

crystallised, but usually its boundaries are indistinct, also from corrosion. (*See* Pl. 3. Fig. 10.) The felspar in both lavas show corrosion, but in that of Mount Leura some crystals show well-defined boundaries, and suggest two separate crops of them.

Magnetite is conspicuous from the irregularity in the outline of the sections, from its rarity in the olivine, and also because of its abundance as dust inclusions in many of the other minerals. Pleonaste shows rounded and corroded forms with the felspar crystals packed up around it, as represented in Pl. 3, Fig. 11.

(*i*) Sapphire Deposits.

In the different workings on the field the thickness of the sapphire wash varies considerably, in some places being only a few inches thick while in others it amounts to several feet. The bottom is usually a reddish clay resting on decomposed schists and slates. Mistakes have been made in supposing this red clay to be invariably the bottom, since below the red clay another and sometimes a richer bed of wash has sometimes been found.

Some of the workings contain only medium-sized boulders, while others contain boulders too large to be removed by hand. Frequently the sapphire wash is very clayey and requires "puddling" before the sapphires can be extracted, and under such conditions the "wash" requires to be richer to pay for the extra trouble. Much of the wash is loose and friable and free from clay, and then the sapphires are obtained by "dry sieving."

No general rule can be given to determine what the deposits will be like in any particular place, as their character is affected by so many local conditions. In the claims the wash may change from a reddish, gravelly clay to a very dark, fine, friable soil, or from a black soil to one which is white and marly, all carrying sapphires; and from being a very shallow surface deposit it may change to one, perhaps seven or eight feet deep.

In the western deposits at Tomahawk Creek, and also at the other creeks in this direction, the wash is of enormous thickness. Very little prospecting has been carried on in this part of the district, so the actual depth of the wash is unknown. No surprise would be felt, however, if the wash were to be found fifty feet deep, as it rises high up into terraces far above the present streams.

In some of the workings no bottom, so far, has been found, but in these instances—on Retreat Creek—the wash has not been sufficiently rich to induce prospectors to sink deeper. Sometimes the prevalence of large boulders make the work too laborious for deeper sinking, and the ground cannot be worked without hoisting machinery. The part of the wash which carries the sapphires is often very irregular, sometimes occurring as small patches in the otherwise almost barren portions, while the sapphires in other places are generally scattered throughout the wash.

As the older formations which form the bottom of the deposits vary in composition, so does the colour of the deposits which rest on them. Where the bedrock is decomposed slates and schists, the wash is inclined to be reddish, where granite is present the wash is yellowish, and where the basic volcanic and intrusive rocks are on the bottom the wash is almost black.

The bottom as well as the wash is also very irregular, from which it may be supposed that the water in producing such effects was by no means gentle in its action. Where the wash has been removed in some of the old workings, an inspection shows the bottom to consist of a series of pot-holes, sometimes communicating with one another, but frequently having no connection at all, as shown in Pl. 11.

The mineral and rock constituents of the wash do not vary to any great extent over the fields, the most noteworthy being, as mentioned before, the abundance of "billy" in the wash of Retreat Creek and other creeks trending east, and the absence of it in most of the deposits on Tomahawk Creek and the creeks trending northerly.

The peculiar situation of the deposits in occupying the tops or sides of low ridges may be explained by referring to Pl. 9, where the changes are shown by a series of sketches.

5.—THE SAPPHIRE FIELDS.

The important deposits of the district may be separated into the following four main divisions:—

(*a*) Retreat Creek and Sheep Station Creek.
(*b*) Policeman Creek.
(*c*) Tomahawk Creek.
(*d*) Central Creek.

Several less important deposits occur (described under "Smaller Fields"), of which those of Boot and Kettle Creek are perhaps the most extensive. Isolated deposits also exist near Borilla Railway Station, at Glendariwell, and at Argyle Creek (*see* Map 1). Sapphires have been picked up on the surface of a gravelly wash at Llandeillo to the north, at the horse-paddock of Bevendale out-station, and in the direction of Peakvale Station, places not shown on the accompanying map.

(*a*) Retreat Creek.

Small patches of sapphire wash occur on the south side of Retreat Creek, a few miles above its junction with Policeman Creek. Some fine stones have been picked up on the surface, but prospecting has shown that the stones generally are too small for miners to pay much attention to them. These deposits are the lowest and the most easterly on the field, and, being near the level of Retreat Creek, are surrounded by recent alluvium. The accumulation of this alluvium would indicate their being probably of greater extent than what is apparent from the surface. This portion of the area examined appears to be subject to inundation, so that similar deposits—such as they are—may be completely covered by the alluvium brought down by the creek.

Further up Retreat Creek, on the northern side, there is an area of sapphire-bearing country about four miles long, extending from one mile east of the old telegraph line to near Mount Bullock. (*See* Map 2.) On these deposits more work, on the whole, has been carried out than on any others in the district.

To the east and west of Ruby Hill (*see* Map 2), and also on the top of it, the wash varies in thickness. In some of the claims the wash is several feet thick, examples of which are to be seen on the claim of Mr. Newsome and that of Mr. McInnes. The rock boulders and pebbles in the wash include several varieties of "billy," red and brown jasper, basalt, hornblende rock, decomposed slate, indurated slate, sandstone, quartz, and diorite, whilst amongst the smaller pebbles are found fibrous hornblende, magnesite ("white clinker"), tourmaline, topaz, pleonaste, rock crystal, and several varieties of chalcedony.

The bottom of the wash is a decomposed slate, forming a reddish clay, while the surface is either a reddish clayey gravel or black soil. On Mr. Newsome's claim, several rubies have been found, some of which are banded with blue sapphire (*see* Plate 7, Fig. 2), but compared to the blue, green, and yellow sapphires, they may be considered exceedingly rare stones.

At Mr. Innes' claim the wash is very deep, and some trouble is caused by the very heavy boulders which it contains. Some angular prices of chalcedony and jasper found in this claim have been shed from the outcrop of an older formation in the locality. Among the heavy boulders in this claim, in rather a fine wash, two fine yellow sapphires, weighing nearly fifty carats each, were unearthed.

Many of the other claims here, of which Mr. Godlipp's might be mentioned, have produced some fine stones, and this portion of the field for this reason has always been looked upon with favour by the miners of experience.

At the Bessie Workings (*see* Map 2) the wash is very similar to those last mentioned, but the bottom is composed of slate and hornblende rock, both much decomposed in places. The excavations at the time of the inspection, which were being worked by C. Thomas and party, showed indications that the richer portions of them were about exhausted. The hill, however, has not been worked all over the surface, so that other equally rich patches might he found not far away.

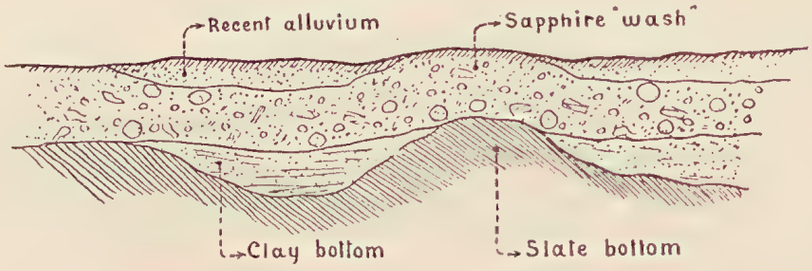
The sapphires found in this length of four miles are blue, green, yellow, and parti-coloured. Blues are generally dark, but occasionally light blues are found, while the green stones, particularly in light shades, are very fine gemstones when free from flaws. Corundum is a usual accompaniment of the good stones, but is worth very little at the present prices, and so is not paid attention to. Pyrope garnet is found as small pebbles, and zircons in several shades of colour are not rare. Some fine hyacinths, a variety of the zircon, are also found at times.

The recent alluvial of Retreat Creek separates the Bessie Workings from others further south, and also from those of Hunt's and Poverty Hill.

At Hunt's Claim the work has been carried on in a systematic manner, and water close at hand has been conserved for washing purposes. The wash is shallow, averaging one foot in thickness, and rests on a bottom of slate or clay. Some of the wash contains ironstone and angular quartz pebbles, but otherwise is similar to that lower down Retreat Creek. One portion, however, can hardly be considered an alluvial deposit, being nearly all composed of disintegrated portions of the slate which forms the bottom.

The sapphires found in Hunt's Claim comprise some large blue stones, and others of a beautiful light yellowish-green. Zircons, garnets, and amethysts are found here occasionally, and pleonaste is very common. Fig. 6 represents a section of the wash at Hunt's Claim, and shows the wash to rest partly on the slate and partly on a clay.

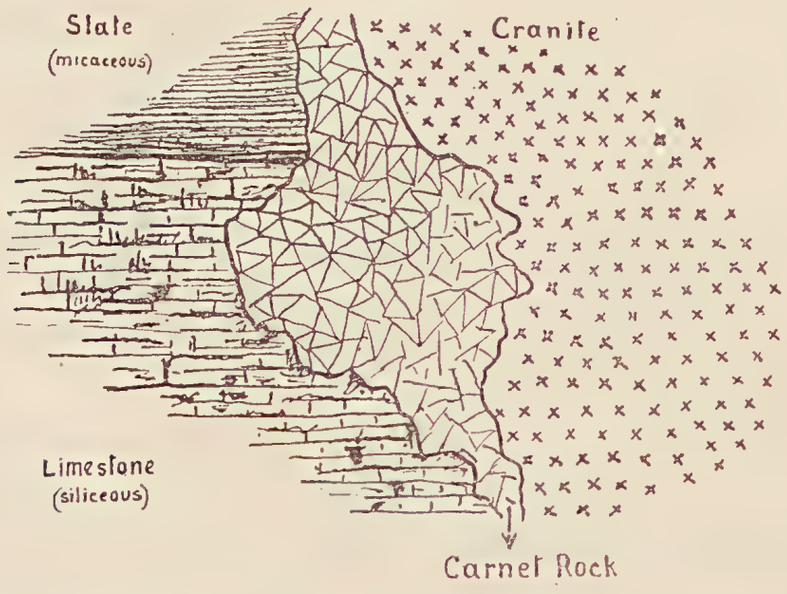
Fig. 6.



Section of Sapphire Wash at Hunt's Claim.

At Poverty Hill the bedrock is partly granite and partly micaceous slate with interbedded limestone. At the junction of the granite and limestone a massive garnet rock occurs with epidote. The garnet is crystallised in part, and the epidote, as well as being in veins, occurs as nests of fine accicular crystals in the interstices between garnet crystals, a feature showing the epidote to have been formed subsequent to the garnet. Fig. 7 shows the general position of these rocks on Poverty Hill.

Fig. 7.



Garnet Rock at the Contact of Granite and Limestone, &c., Poverty Hill.

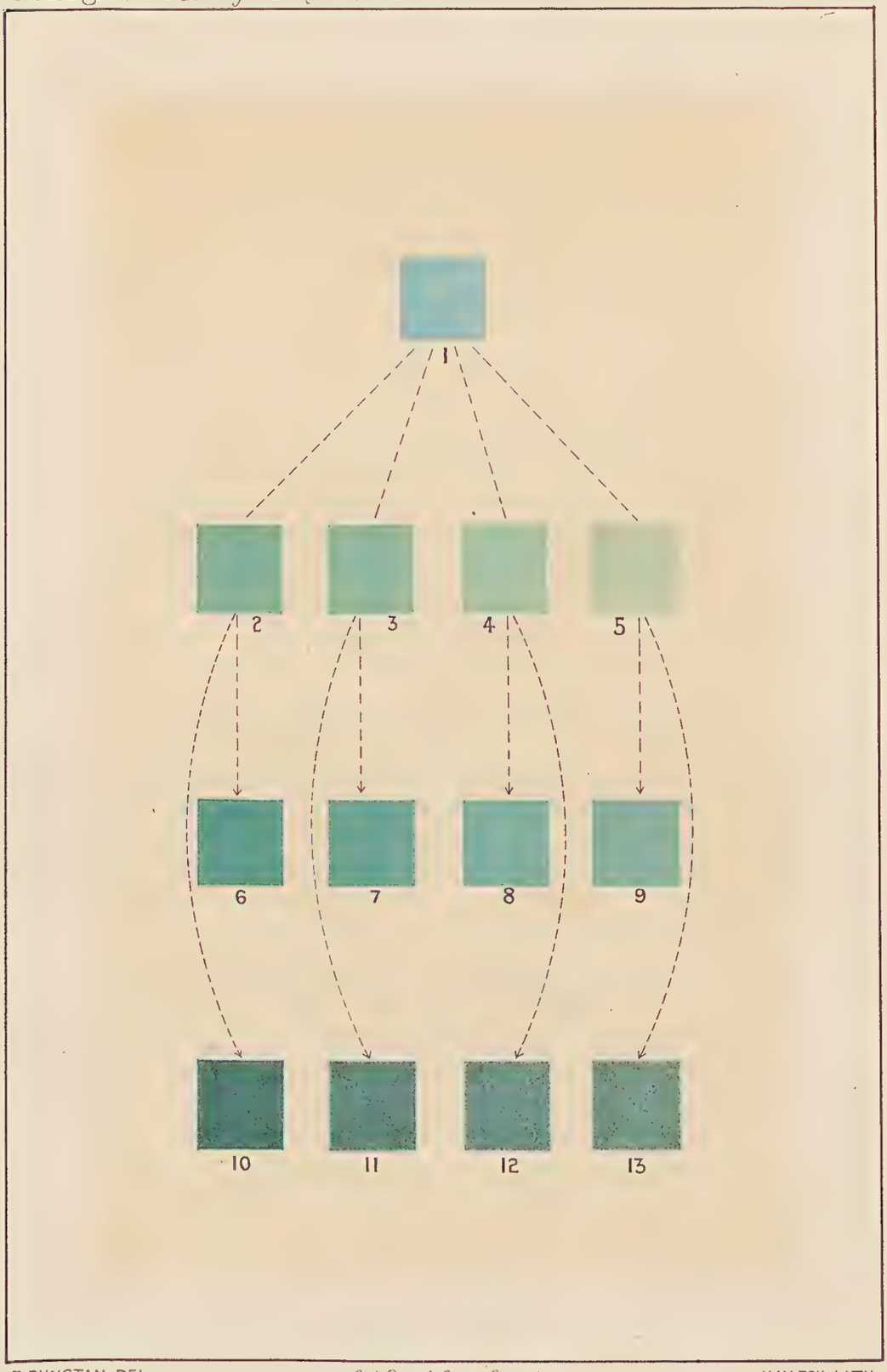


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Diagram

Showing the effect of Pleochroism in the Cutting of Anakie Blue Sapphires.

GEOLOGICAL SKETCH MAP

To accompany Report

ON THE

ANAKIE SAPPHIRE FIELDS

CENTRAL QUEENSLAND

BY

B. DUNSTAN F.G.S.

Assistant Government Geologist

1901

Scale of Miles 0 1 2 4 6 8

DRAWN BY H.W. FOX AT THE GEOLOGICAL SURVEY OFFICE BRISBANE 1902

LOCALITY MAP

REEERFNCE

- Recent Alluvium
- W Alluvial Sapphire deposits
- B Basalt
- R Rhyolite
- D Diorite &c.
- S Star Beds?
- F Slates (clay taleosc &c)
- M Metamorphic rocks
- G Granitic rocks
- Sy Syenitic rocks

Altitudes thus 810'

NOTE÷Geological boundaries & positions only approximate

LINE OF SECTION (A) (B) (C) (D) (E)

Alluvial Deposits occur about here and Sapphires are occasionally Found on the surface

Syenitic Rocks

Red Porphyry

Syenite with Porphyry Dykes

Granite at base of mountain

Basalt capped

Old alluvial Gold Workings

Small Sapphires occur here

Small Sapphires found here

Small Sapphires have been found on this side of the Railway Line

Old Copper Mine

Ironstone "Blows"

Mining Camp

Newsome's Camp

Old Siding

Tin Hut

Hunts Gate

Rhyolite

Massive Conglomerates

Massive Country very Rugged

Massive Conglomerate Ridges

Schists & Gneisses

Quartzites & Schists

Alluvial Gold found here

Old alluvial Gold Workings

Alluvial Gold below Basalt

Reids Waterholes

Iguana Flat

Black Gin

Yard

Wells

Hut

Gate

Fence

Road from Peak Vale Station

Road to Clermont

Old Aramac Road

Basalt Road

Old Telegraph Line

Central Railway

Carbine Creek

Cattle Creek

Pigeon Creek

Boot & Kettle Creek

Serpentine Creek

Central Creek

Tomahawk Creek

Branch Creek

Cattle Creek

Retreat Creek

Sheep Station Creek

Six Mile Gully

Washpool Ck.

Spring Creek

Ruby Creek

May Creek

Policeman Creek

Retreat Creek

Zigzag Ck.

North Ck.

8v Ck.

Mt Zigzag

Mt Hoy 1800' 1400' 1950'

Mt Newsome 1250'

Mt Leura 2000'

Mt Ball

Mt Pleasant 1310'

Mt Tabletop

Black Knob

Bald Hill (Bottle Tree Knob)

Basalt Hill

Policeman Knob

Mt Clifford Mine

Copper Workings

Black Peak 1900'

Rhyolite

Carbine No 5

Carbine No 2

Lancewood Ridges

Peak Vale

Triangulation No 1

Triangulation No 2

Triangulation No 3

Keilambete

St Helens

Anakie Downs

Anakie Hill

Zigzag Range

Drummond Range

Tomahawk Range

Lamia Range

Anakie Range

Argyle

Winterbourne

Peak Vale

Keilambete

Glendarriwill St 194 M. 803 FT

Anakie St 192 M. 815 FT

Withersfield St 204 M.

Borilla St 199 M. 913 FT

Clermont Capella Emerald Rockhampton Springsure Rolleston Anakie Sapphire Fields Withersfield Comet Duaringa Bogantungan Westwood Mt Morgan Yeppoon Keppel Bay Cape Capricorn Curtis I Gladstone Port Curtis Rednerville Raines Calliope Kroombit Cape Clinton Cape Manifold Pacific Ocean

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The sapphire wash is very much like that at Hunt's Claim, but the disintegrated slate is not so prevalent. The sapphires are blue, green, parti-coloured, and occasionally yellow. Some of the green stones are large, and very suitable for cutting, but the colour of the blues are generally too deep.

To the north-west of Poverty Hill, at the Withersfield Sapphire Syndicate's Reward Claim, between Retreat Creek and Sheep Station Creek, there is another sapphire-bearing deposit. The wash rests on a bedrock of slates and schists, and forms the crown of a ridge crossing and extending both easterly and westerly outside the area of the claim.

The wash is remarkable for the large masses of "billy" it contains, a reference to which has previously been made. The "billy" in this locality varies considerably in colour and texture, some being white and fine-grained, some coarse and dark, and others containing large rounded pebbles. Pebbles of basalt, quartz, and red and yellow jasper are also to be found in the wash.

Some very fine gemstones, it is said, have been taken off this mine, and undoubtedly a large amount of pioneering work in the sapphire industry has been carried out by those who are or have been associated with it. Where the wash occurs the sapphires must once have been confined to a channel with slopes leading down to it, and while the hills existing at that time have entirely disappeared and depressions formed instead, what were once the lower parts now form the sapphire ridges. The diagrams on Pl. 9 show how these changes have been brought about.

The wash to some extent has become scattered by weathering agencies, but still the main portions are to be found on the top of the ridge. As a guide to future operations in this locality it may be stated that results cannot be expected to be good in the gullies or spurs, except where they just lead off from the main ridge.

On the Reward Claim, and in the neighbourhood, crystallised corundum has been found in perhaps greater quantities than on any other part of Retreat Creek, and some of the pieces found weighed more than a pound, a very unusual weight on the Anakie Field. Recently a large yellow sapphire was obtained in a rivulet close to the edge of the wash on the ridge, which, after cutting, weighed thirty-three carats.

Both on the eastern and western sides of the Reward Claim a number of miners have been obtaining some fine sapphires and also a few hyacinths of perfect colour.

The Freehold Claim of the same firm is situated about a mile to the west of the Reward Claim (*see* Map 2), but at present is not being worked. From the character of the wash it is supposed that at one time it was connected with the deposits at the Reward Claim, although older formations are now exposed between them.

In describing the sapphire deposits further west, a perusal of both Maps 1 and 2 will show the sapphire wash to be broken up into small patches, and that these patches occur near Washpool Creek as well as near Retreat Creek. At Keilambete Station sapphires have been found about the homestead, but no systematic prospecting work has been undertaken.

Near the heads of Washpool Creek, and also near the junction of Argyle and Retreat Creeks, the sapphire deposits have been worked, but no information concerning the stones found is available, it being some years since the place was abandoned. However, they partake of the general character and appearance of the sapphire deposits lower down Retreat Creek.

Sheep Station Creek is a branch of Retreat Creek, having its source at Mount Leura. Iguana Flat, a locality where there is a large area of sapphire wash, is drained by two watercourses falling into Sheep Station Creek on its northern side at Reed's Waterholes. The sapphire deposits occurring at Iguana Flat, although on the fall of Sheep Station Creek, do not seem to have any connection with those of Retreat Creek, so striking is the difference in the stones found in the two places; neither do they resemble the stones of Policeman Creek, with which, from the trend of the sapphire belt, they appear to have some connection.

The wash of Iguana Flat is generally very clayey, and is often several feet in thickness, and extends very irregularly over a large area. In some of the workings a black soil covering has to be removed before the wash is reached, and frequently on the surface there is nothing to indicate the presence of sapphires, or even sapphire wash.

At this locality, a few weeks before the inspection of this part of the district, some Clermont gold-miners started work. From their previous experience at Clermont, that alluvial gold sometimes occurred below black soil, they supposed that sapphires might be found under similar conditions, but against the advice of experienced sapphire miners they sank through the black soil to prospect, and were rewarded by finding some of the stones. This was quite a new although, naturally, not an unexpected development, as black soil occurs in so many places around the sapphire wash, and is also of more recent formation.

The rock boulders and pebbles occurring with the sapphires on Iguana Flat are limited almost entirely to "billy," this rock comprising about ninety per cent. of the whole, the rest consisting of basalt, quartz, and ironstone. The bottom is a clay, with granite and syenite as a bedrock.

The minerals associated with the sapphires are similar to those of Retreat Creek, but generally are of larger size. The sapphires themselves are characterised by their large size, small stones being in less proportion than the large ones, and frequently clear stones are contained in the interior of coarse corundum crystals.

When miners who have had little experience in this class of mining obtain these large pieces of corundum, they generally place a high value on them, but only a small proportion of good material is found in the centre of them.

(*b*) Policeman Creek.

On the south side of Policeman Creek a large area of sapphire wash occupies the rising ground near the bank, but without touching the present channel. The workings are mostly on the western and central portions, the easterly lower end not containing sufficient stones of marketable size to make the working of it remunerative.

On the extreme western end the claim of Mr. Halliday is situated, and close to it is that of Mr. McCrystal, while more towards the centre, on the eastern side of the north and south dividing fence, are several other claims, of which Mr. Lidstone's is the most important. In McCrystal's Claim a diamond was found at the time of the writer's inspection of the field, reference to which will be made in a subsequent chapter.

The bottom of the wash consists of slates and schists which, more or less, are ferruginous and decomposed into reddish clay. The wash consists of abundance of boulders of white "billy," ironstone, and quartz, with small pebbles of basalt, aventurine quartz, greenish quartzite, fibrous hornblende, and pleonaste. The sapphires found are blue, yellow, green, and parti-coloured, the blues predominating. Policeman Creek "blues" are considered the best blue sapphires on the fields.

On the north side of Policeman Creek there are deposits, which at one time were probably connected with those on the south side. The principal claims are around the "Tempest" workings (*see* Map 2). The "wash" extends both to the east and west of these workings, but it has not been prospected to any extent.

The wash on the north side is generally clayey, but sometimes is a whitish marl containing several per cent. of carbonate of lime and magnesia irregularly mixed with black clay. The associated minerals are pleonaste, zircon, titanic iron, and rock crystal, the former mineral being quite common. Further up on this side of Policeman Creek the sapphire deposits continue for some distance, and then cross to the south side, where they rise up on the watershed to connect with the deposits at Iguana Flat. Very little work is in progress on the upper portion of Policeman Creek, but there are a number of old workings showing that this part has been previously prospected.

From Iguana Flat, where the sapphires are large, to the lower end of Policeman Creek, there is a gradual diminution in the size of the stones, from which it might be assumed that Policeman Creek stones have come from the direction of Iguana Flat—a theory, however, which there is objection to, as it is generally admitted the blue stones at Iguana Flat are not of such a good quality as those at Policeman Creek.

(*c*) Central Creek.

Very little is known of the sapphire deposits existing on the western side of Central Creek. Their position and area has been fixed approximately (*see* Map 1), and enough was observed from a rapid inspection to show that immense bodies of wash, forming whole hills and ridges, can be traced continuously for miles. What the ultimate results will be when they are prospected it is impossible to say, as they might be very poor in sapphires or they might be exceedingly rich.

On the surface, wherever inspected, pieces of corundum and pleonaste, and occasional fragments of sapphires of a light green colour were picked up, and from a cursory inspection many favourable-looking spots were noticed for prospecting operations. No indication could be seen of any mining work, so that if there had been some carried on in the past it must have been confined to simple "surface-picking." The creek is twenty-seven miles north-west direct from the Anakie Railway Station, and by the road is about thirty miles, so it is not surprising that more attention has not been paid to it, especially as the Retreat Creek and Policeman Creek deposits are so much closer to the railway line.

The sapphires generally found are shades of green, some of the lighter being very beautiful, while blues in all shades are not so common. Corundum, pleonaste, and titanic iron are common, but zircons were not observed at all, although possibly occurring in some of the deposits.

The western sapphire deposits evidently are more uniform in their occurrence than those on the eastern fields. They contain heavy boulders and also sandstone pebbles derived from the Drummond Beds higher up the stream. Pebbles of "billy" are very seldom seen. Granite is to be observed all over this part of the district, and evidently is the rock on which the deposits have been laid down.

(*d*) Tomahawk Creek.

The sapphire deposits on Tomahawk Creek are the most extensive in the whole district. They are in places a mile in width and several miles in length, extending from Mount Hoy to below the junction of Tomahawk and Central Creeks (*see* Map 1). The whole of some of the ridges separating Tomahawk Creek from Serpentine Creek are composed entirely of wash, so that the deposits must be of great thickness. These huge deposits have been prospected in places by sinking shallow trenches, but the area so prospected is exceedingly small when compared to its vast extent. The top end of the Tomahawk deposits, near the foot of Mount Hoy, are the highest in the district, being 1,400 feet above sea-level, and nearly 600 feet above the sapphire deposits at the lower end of Retreat Creek.

The trend of the wash from Mount Hoy is towards the north, although there is a small patch of about two miles S.S.E. of the mountain, on what is known as the Ten-mile Gully, one of the heads of Retreat Creek. This deposit has no present connection with those of Mount Hoy, but its presence here indicates the possibility of the deposits of Mount Hoy and Retreat Creek being connected at some previous time.

In trending towards the north from Mount Hoy, the sapphire deposits seem to have split into two channels, one going due north for a short distance, then bending away slightly to the east and crossing Koski's Creek. The other channel from Mount Hoy trends north-easterly down and across Koski's Creek towards Mount Newsome. A break in the deposits occurs here, but they are continued again on the northern side of Mount Newsome, and, after winding about on the eastern side of Koski's Creek, join the other branch a little lower down.

From where the two branches join no break lower down was observed in the deposits. The lower end of the deposits occupy, as one belt, the ridges between the Serpentine on the east side and Koski's Creek and Tomahawk Creek on the west, crosses the latter creek just above its junction with the Serpentine, and then trending north-westerly crosses Central Creek about a mile above its junction with Tomahawk Creek.

The total distance along which the deposits are found from Mount Hoy to Central and Tomahawk Creek junction is altogether about fifteen miles. Further than this the deposits have not been traced. It is extremely improbable, however, that the deposits do not occur still further north, and on the information supplied by Mr. H. Monk, who knows this part of the district very well, sapphires have often been found by station employees when mustering cattle in the neighbourhood of Bevandale, an out-station of Peak Vale.

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CUT GEMSTONES, ANAKIE.

Over this large area no attempt could be made to determine the more favourable localities for prospecting operations, but wherever inspected the mineral pleonaste, the persistent associate of the sapphires, was to be seen, while occasionally corundum and fine green sapphires were found. The wash is similar to that of Central Creek in every respect, and also the same bottom of granite formation is to be observed except near Mount Hoy, where the wash evidently rests on the sandstones and shales of the Drummond Beds.

The colour of the sapphires found on Koski's Creek and Tomahawk Creek are of blue, green, and yellow shades, but the green stones are the more numerous. Some of the green stones are so finely coloured that they have become recognised amongst the miners on the fields as the standard of excellence as "Tomahawk Greens."

(*e*) Smaller Fields.

Boot and Kettle Creek.—Several patches of sapphire wash occur on this creek, which is to the north of Policeman Creek, but they are not so extensive as those on Policeman Creek or Retreat Creek. The patches of wash are said to be small, and the sapphires which they contain also are small, and for both reasons do not offer much attraction to the gem miner. Some good green stones have been found, but the blues generally are of inferior quality. Pleonaste and zircon are present in the wash as small pebbles, and billy and basalt boulders are common.

Borilla.—A small area of sapphire wash occurs on the northern side of the railway line, about a couple of miles north-easterly from Borilla Railway Station. The wash resembles that of Retreat Creek. Evidently the returns by the prospectors here have been unremunerative, as the place is not being worked at the present time.

Argyle Creek.—Concerning this locality little is known, and those who have been prospecting it have abandoned it because, it is said, the stones found are mostly yellow. On this creek a fine yellow stone was picked up weighing twenty-two carats.

Woodbine.—The position of this locality is not shown on the accompanying maps. It is situated at the 213½-mile peg on the railway line, and the wash is in the railway ballast quarries. The stones are said to be good although small, but they are not in sufficient numbers to pay for their extraction.

Glendariwell.—Stones have been found in several places along the southern side of the railway line, in the vicinity of this station, but those found up to the present show that they are too small to be worth mining for.

Llandeillo.—At this place, which is on the Clermont-Anakie Road, being about twenty-eight miles directly north-north-east of Anakie, small sapphires were found at an old cattle yard between McKean's and Miller's selections. The attention of Mr. Godlipp was drawn to them, first by the presence of billy, the "sapphire boulder," but so far as prospecting has shown they are by no means numerous.

6.—METHODS OF TREATING SAPPHIRE WASH-DIRT.

For convenience of reference, the conditions under which the sapphires occur and the methods of treatment according to those conditions have been placed in a tabular form.

The table does not show all possible methods of treatment, as many of the miners work only with an ordinary hand sieve, and when the ground is too damp for dry-sieving they suspend operations until the conditions are again favourable. This practice has been found to answer well enough in some of the workings, as the wash when dry will pay to treat dry, but will not pay to cart to water.

When hand-picking is practised, it has been found more profitable to break up the clayey wash and pick the stones out by hand, rather than to cart it to water. Another reason why the dry methods are adopted even when the wet methods would be far more suitable, is that the miners have not horses and carts to take the wash to the creeks, wells, or waterholes.

Methods of Treating Sapphire-Bearing Wash-dirt.

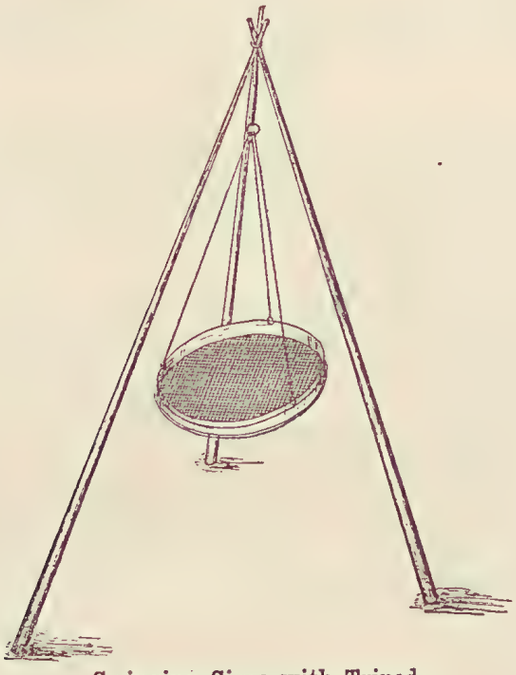
Condition.	Treatment.
If sapphires are small and water scarce—	
1. Wash loose and dry	Suitable for "screening" and "dry-sieving" or "dry-jigging."
2. Wash loose and damp	Suitable for "wet-jigging" or "tomming."
3. Wash clayey	Necessary to "puddle" before "wet-jigging."
If sapphires are large and water scarce... ...	Hand-picking all the wash, including all the clayey portions.
With a good water supply...	Working all the wash by one or more of the processes of "puddling," "wet-jigging," or "tomming," with or without screening.
If sapphires occur on the natural surface of wash, or wash turned over to expose fresh portions of it	Hand-picking, or "specking" during rainy weather.

Appliances.

The equipment of a gem-digger is not a very elaborate one when prospecting new ground, and resembles that of a gold-digger, except that a sieve is used instead of a prospecting dish.

The sieve used is generally of a circular shape, having a wooden frame and a wire screen bottom of a mesh about $\frac{1}{8}$ or $\frac{3}{16}$-inch, according to the size of the sapphires expected to be found. Heavy stones in the wash are picked out by hand, and those of about an inch in diameter are removed by a coarse top screen over the sieve. Frequently this top screen is dispensed with.

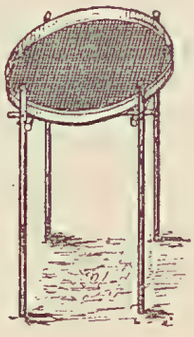
Fig. 8.



Swinging Sieve with Tripod.

Instead of circular sieves others of square shape are used, having either a woven wire bottom or one of perforated sheet-iron. A tripod is used by some miners from which to suspend the sieve (*see* Fig. 8), while others prefer a stand of two or four slender upright pieces of wood on which the sieve is placed and shaken, the laths of wood acting as springs, as in Fig. 9.

Fig. 9.



Sieve on Four Spring Battens.

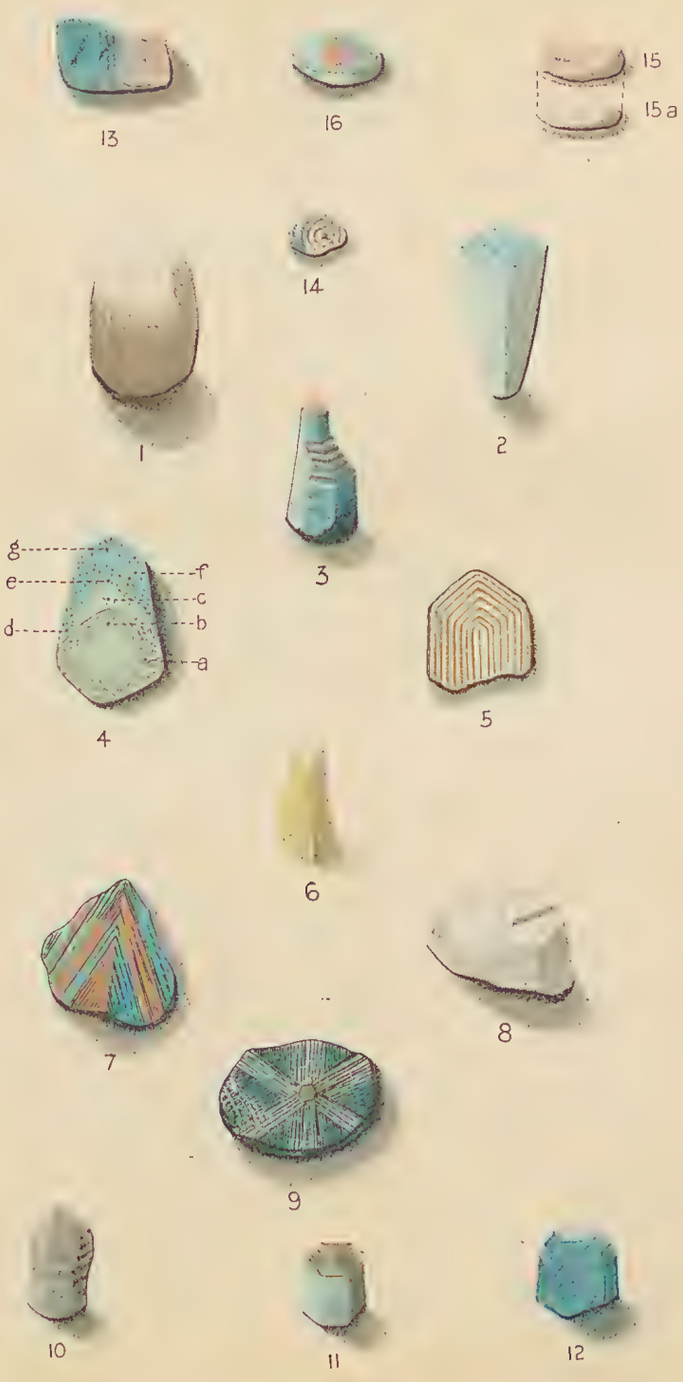
The dry-jigger is an improvement on the sieve, being a square wooden frame about four feet long and two feet wide. It is set up about three feet from the ground on the ends of four flat upright springs made of brigalow wood. (*See* Plates 8 and 10.) The bottom is a screen of coarse wire of $\frac{1}{8}$ or $\frac{3}{16}$ inch mesh.

The dry-jigger is modified by having the box suspended from a framework instead of resting on springs, a suggestion of Mr. Logan of the sapphire mines. This arrangement produces an easy swinging motion, convertible into a short sudden one by the operator, but with the spring-jigger the same sharp motion is produced automatically by the action of the springs.

If the wash contains a large number of pebbles it is sometimes thrown on to an ordinary gravel screen to remove them before jigging. The gravel screen removes the coarsest material, the jigger removing the finest, while the intermediate grade of stuff is that in which the sapphires are looked for.

In looking for the stones in the sieves and jiggers after the fine material has been removed the wash is simply turned over by hand and the sapphires picked out as they are found. When no water is used at all, and the stones more or less coated with clay or iron oxides, it would seem hardly possible to prevent considerable loss in the operations. The miners, however, think otherwise.

In the wet methods of treatment the sieves and jiggers used are the same as for dry treatment, but in addition a table of bark or sheet-iron is usually set up close by, on which the stuff is thrown. As all the wash is wet the sorting is done more expeditiously, and apparently with less chance of losing any of the stones than in the dry way. (*See* Plates 8 and 10.)



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CORUNDUM CRYSTALS, ANAKIE.

A trough is always used in wet-jigging to soak the wash, and also to puddle any clay which may be present, both operations effecting a considerable saving of labour and water. The material of which the troughs is made are various. Some are made of galvanized iron, others of bark or of slabs of wood, but generally they are made in one piece from a hollow tree.

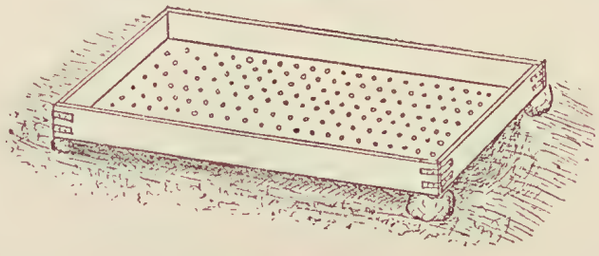
In making a trough of the latter kind, a log of about eighteen inches or two feet in diameter is sawn to the length required (about ten or twelve feet) and one side cut away. If not sufficiently hollowed it is made so, first by burning away a portion by making a fire in the interior, and afterwards chipping it into proper shape with an axe or adze. The two ends are closed by boards, in one of which a slide is made to allow of cleaning out when required. The diameter of the trough should not be increased or decreased much outside the limits mentioned, otherwise the manipulation of the wash will not be convenient. Plate 8, Figs. *b*, *f*, shows two such troughs.

Instead of this kind of trough a square-shaped one is sometimes used. It is built of slabs, and is about four feet square and eight inches deep (*see* Plate 10 at *b*), and sunk into the ground.

The sorting table is placed just below the level and at the end of the wet-jigger, one end of which is left open. After washing all the material in the jigger it is scraped on to the sorting table where it is more conveniently examined for sapphires, &c. (*See* Plates 8 and 11.)

Working with the old-fashioned "tom" is practised by several of the sapphire miners, and undoubtedly produces good results. As used on the Anakie Fields it is a wooden box about six feet long, three feet wide, and about eight inches deep, and having a perforated sheet-iron bottom. (*See* Fig. 10.)

Fig. 10.



A "Tom" as Used in Sapphire Washing.

The "tom" is placed in an inclined position near the edge of a waterhole or other reservoir, and is filled to about half its capacity with wash-dirt. A small "race" carries the water from the reservoir to the head of the "tom," where it is lifted with a hand bucket and thrown over the wash, which at the same time is being kept stirred up with a shovel by another operator. After being cleaned, the material is not removed for sorting, as this operation is performed on the bottom of the "tom" and not on a table.

All these appliances are very simple and easily constructed, and when worked by small parties of miners will answer all purposes. Sluice-boxes are not used on the fields on account of the insufficient supply of water during the greater part of the year, but there is no doubt whatever that sluices could be arranged to save the sapphires if a sufficient supply of water could be obtained by well-sinking or by conserving in dams. Sluices would have the additional advantage of saving any gold in the sapphire-wash, which at present passes away in the tailings.

7.—MINERALOGICAL NOTES.

(*a*) Sapphires.

Crystalline Form, Cleavage, Twinning, Inclusions, Specific Gravity, and Hardness.

The hexagonal pyramid with its modification is common, but the prism is comparatively rare. The simple barrel-shaped form (Pl. 6, Fig. 1) was observed with and without any hemihedral truncating faces. A crystal having two opposite faces cut out has the remaining four largely developed, and gives a lozenge shape to the basal section (Pl. 6, Fig. 2).

Very acute rhombohedrons with terminal basal planes occur (Pl. 6, Fig. 6), also pyramids with curved faces (Pl. 1, Fig. 2), and also small rhombohedrons developed on a large basal plane (Pl. 1, Figs. 5, 5*a*). Variations in the building up of the form of crystals are shown in several specimens. One example (Pl. 6, Fig. 4) shows a primary (?) pyramid (*a*) with a short terminal pyramid (*b*) without any development of a basal plane, but the crystal has continued the growth (*c*) from the primary (?) pyramid and overwhelmed the terminal one. Another development, starting at the base (?) of the primary pyramid has formed over this a covering pyramid (*d*), also with a terminal pyramid (*e*). Finally, the pyramid (*d*) has continued its growth (*f*) and formed a terminal pyramid (*g*) to complete the present outline of the crystal. The sketch shows the crystal in section along the principal axis. The above stages in the building up of a crystal suggests a sort of "cone in cone" development. Sometimes in a crystal there are bands of a dark colour alternating with those of a light colour along the basal plane as in Pl. 7, Figs. 4, 5, 7, 16*a*.

Some crystals, evidently, have had only a pyramidal growth, but are remarkable for the apex being of a different colour to the other portion of the crystal (Pl. 7, Fig. 11). This crystal suggests that the growth has been terminal and not lateral. Another specimen shows a secondary lateral development on one prism face only, the first and second development being coloured yellow and blue respectively (Pl. 7, Figs. 9, 9*a*), while two other crystals show acute rhombohedrons of one colour (yellow) enclosed in a prism of another colour (Pl. 7, Figs. 1, 15).

Basal sections show other peculiarities. Some crystals have single narrow bands on the periphery (Pl. 7, Fig. 3), or a number of alternating light and dark bands as in Pl. 7, Figs. 2, 13, and Pl. 6, Fig. 5. One section shows a partial banding of yellow in an otherwise blue crystal (Pl. 7, Fig. 14), and seems to be a growth of crystal of yellow colour like that represented in Pl. 7, Figs. 9, 9*a*, supplemented by a subsequent lateral envelopment with blue crystal.

A basal terminal plane is divided into three portions (Pl. 6, Fig. 8). From the larger portion the other two are separated by a step formed by the development of a rhombohedral face. The other two smaller portions are also separated from one another by a second step along a second rhombohedral face.

A small basal section shows the hemihedral form of the di-hexagonal pyramid or prism (Pl. 7 Fig. 10), and another similar section shows the effect of rhombohedral crystallization in producing three small dark triangles (Pl. 7, Fig. 6), and a third specimen shows a delicate rhombohedral cloudiness which is serrated in vertical section (Pl. 7, Figs. 15, 15*a*). Fine zonal lines when crossing those resulting from rhombohedral cleavage show the *sagenitic structure* represented on Pl. 2, Fig. 6, when viewed on a basal plane. An oscillation between pyramidal and prismatic growth has taken place on portions of one crystal, producing a terraced effect on the side of it, as shown in Pl. 6, Fig. 3, while a truncation all around from the same cause has produced the effect represented in Pl. 6, Fig. 11.

On Pl. 1, Fig. 3, which diagrammatically represents the basal plane of a crystal of corundum, the emergence or intersection of rhombohedral cleavage planes is indicated by three bars crossing each other at angles of 60°. These bars are comprised of a number of extremely thin parallel cleavage plates, which produce a pearly lustre on the basal cleavage plane. The presence of these bars is supposed to give the "asteria" effect, but this might not be produced from these bars at all. Asteria can be produced by cutting *en cabochon* a stone which has a fine silky zonal banding hexagonal in prismatic section, the rays of which are not apparent in the stone before cutting. The six-rayed corundum is very common all over the field, of which Pl. 2, Figs. 4 and 5, and Pl. 6, Fig. 9, are examples. The arrows in Pl. 1, Fig. 3, indicate the direction of inclination of the rhombohedral cleavages.

Where the basal cleavage faces are very numerous but very thin, and the stone light in colour, the pearly effects of moonstone is produced, and such a stone is suitable for cutting *en cabochon* as an oriental moonstone or cat's-eye. A bronze lustre is frequently observed resulting from the same cause, but in this case the stone is dark-coloured.

In some specimens the basal cleavage is very perfectly developed. Often the cleavage flakes are exceedingly thin, but sometimes the crystal with a perfect cleavage will only separate in thick plates or segments, a character very noticeable in some specimens when they are being polished. In cutting and polishing sapphires the "table" of the stone is made parallel with the basal plane, which is difficult to polish if the stone has a tendency to develop these thin cleavage flakes, but when the cleavage is segmental this difficulty is not experienced. In the former case the difficulty is overcome, it might be stated, by polishing the facet in a direction parallel with the line of the break in the polished surface, or, in other words, at right angles with the direction of the very slight inclination which, from the gem-cutter's error in judgment, the cleavage makes with the facet being polished.

Other peculiarities in the crystalline structure of the sapphires have been observed. In one specimen the increase in the lateral growth of the prism is marked by thin bands of zonal inclusions, some of which also show traces of two rhombohedral cleavages. Along all these planes there is a partial alteration of the crystal, traces of which can be observed on the faces of the prism, as in Pl. 1, Figs. 1, 1*a*.

The rhombohedral cleavage is frequently developed only in two of the planes, and where this is so a kind of "hour-glass structure" is to be observed in basal sections. Such a structure would be as represented in Pl. 2, Fig. 5, with one of the bars omitted.

Penetration twinning has only been observed very rarely. In Pl. 1, Fig. 2, the impression of a small hexagonal crystal is shown on a larger crystal, being a partial penetration-twin, and in some of the waterworn and corroded crystals of corundum traces of penetration twinning have been observed. In the centre of a piece of corundum, showing the three rhombohedral cleavages, a small hexagonal section of very dark crystal was noticed on a polished face, as shown on Pl. 2, Fig. 4. A vertical section of this is shown in Fig. 4*a*.

Massive corundum has not been observed. Large pieces of corundum have been found in several places, but they are portions of crystals which have been more or less waterworn, or previously corroded by molten basalt. It has been proposed to utilise corundum in boring operations, and to even replace diamonds for this purpose. It is only the compact massive corundum which is tough, and the crystalline varieties would be quite unfit for such a purpose in consequence of not having this property, even were there no other objections to it. A parallel may be drawn between the crystalline diamond and the "carbon" or non-crystalline variety of diamond. While the latter, of course, is unequalled in abrading power in a diamond drill, a crystalline diamond would be practically useless. Notwithstanding a previous expression of opinion that Anakie corundum would not be suitable for boring purposes, experiments were made with some of it in one of the Government diamond drills on the Croydon Gold Field, and resulted in a complete failure.

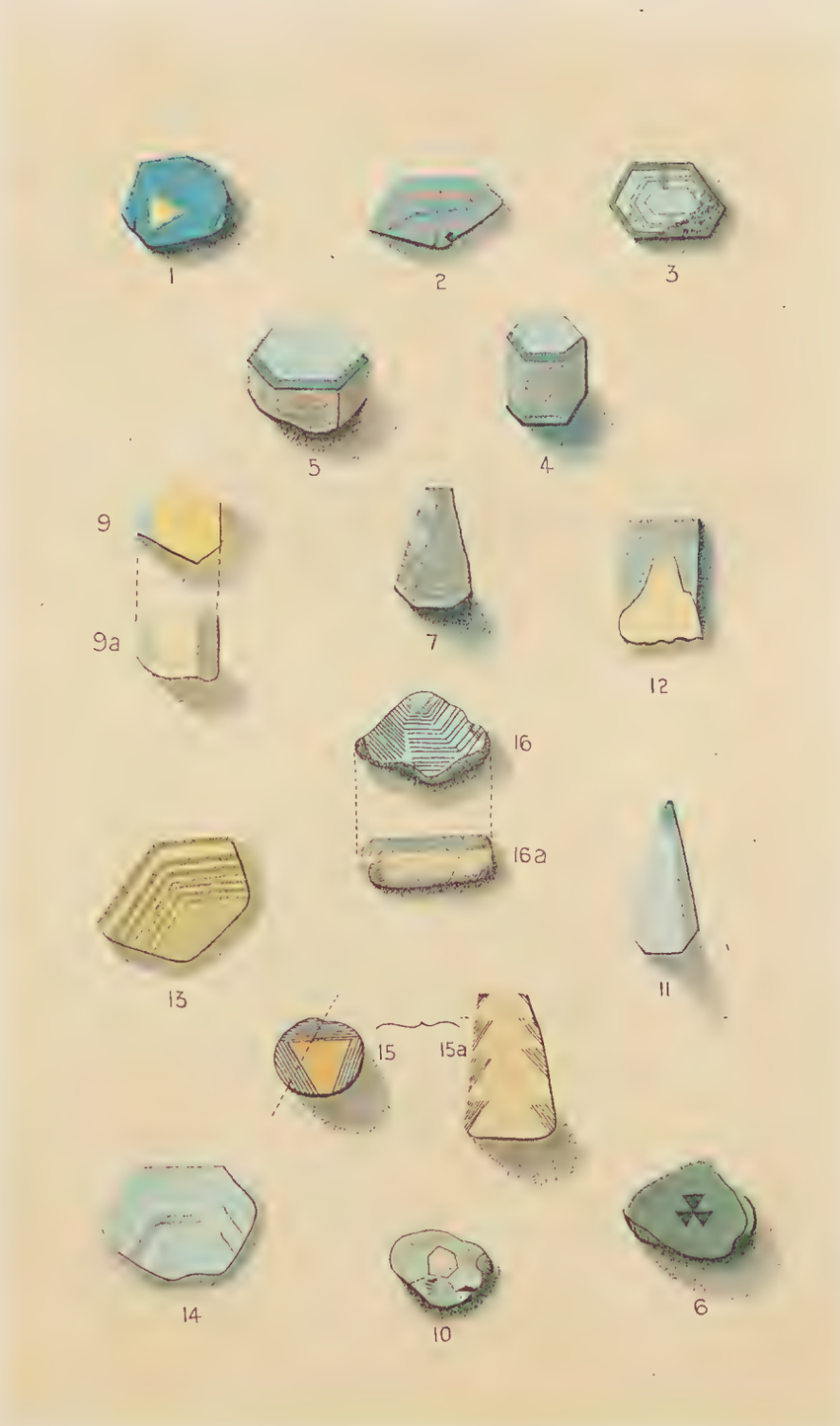
The hardness of some of the Anakie sapphires is variable, and lapidaries have repeatedly stated that the hardness of some specimens is frequently greater than 9 (Moh's scale) and varies even in the one crystal. In slicing with the diamond disc this is specially noticeable, some portions being much more difficult to operate upon than others.

Inclusions in the sapphires are not uncommon and usually are microscopic dust in the form of zonal bands. Fine bodies sprouting out from the zonal bands prove to be magnetite in a dendritic form, and appear to be the result of the alteration of these inclusions. The crystallisation of the magnetite has taken place along four planes, one along the basal cleavage, the other along rhombohedral cleavages.

The colour of the magnetite is from very light brown to dark brown and black. In even a thin section of the crystals the fine delicate films of the mineral can be perceived to overlap one another without touching where they occur between the fine cleavage flakes. Where the overlapping takes place, the mineral is black in transmitted light, but otherwise is very frequently of a pale brown colour. Where the thin plates are being developed along the fine cleavage cracks, their margins are serrated, and where they cross a rhombohedral twinning (cleavage) plane, the mineral at the crossing has not formed, although continued on either side.

In basal section the edges of the magnetite plates in the rhombohedral cleavages, as they cross one another, appear as fine interlacing black lines.

The magnetite also occurs as fine microscopic crystals of normal shape. In several specimens of very deep green sapphire it was observed in dusty masses, and in one crushed specimen it was readily detected both with the blowpipe and magnet.



B. DUNSTAN DEL. GOVT PRINTING OFFICE, BRISBANE. H.W. FOX LITH.

CORUNDUM CRYSTALS, ANAKIE.

Determinations were made of the specific gravity of the blue, yellow, and green sapphires, and also of large crystals of corundum. The variation ranged from 4·009 to 4·050, no specimens indicating a specific gravity below 4. No perceptible difference could be obtained from the transparent crystals of different colour, or between these and the opaque corundum crystals, the maximum variation of the above values being in crystals of one (blue) colour.

Colour and Pleochroism.

The blue varieties are most abundant at Retreat Creek, Policeman Creek, and other places on the eastern fields of the district; while the green stones, so far as prospecting has indicated up to the present, are common on the western fields of Tomahawk Creek and Central Creek.

The parti-coloured stones are common on all the fields, while the yellow stones are very rare. Shades of blue range from a very light to a very dark blue, but the rich cobalt-blue colour—the corn-flower-blue—has not yet been found. The green shades vary from a very lightly tinted pale green to a deep olivine green. The light green stones having just a perceptible golden tinge are very beautiful, and might be appropriately termed *Oriental chrysoberyl*, while the pure green would be the *Oriental peridot*.

Another variety is the *Oriental topaz*, of both canary and orange-yellow shades, of which some fine specimens have been found. The red variety, the *Oriental ruby*, is very rare, but one specimen examined, although defective in other respects, is decidedly perfect in colour, and was obtained from Mr. Newsome's Claim on Retreat Creek.

Purple tinted stones—the *Oriental amethyst*—are very rare, and only occur as a gradation in the colour of the blue or red stones. They, however, have the true amethyst colour. What has been supposed to be oriental amethyst occurs plentifully on the field, but the examination of a number proved them to be ordinary amethyst, the quartz variety. The oriental cat's-eye has been previously referred to.

These colours may then be considered as making up the following eight varieties :—

Sapphire	Blue
Oriental amethyst	Purple
Oriental ruby...	Red
Oriental peridot	Green
Oriental chrysoberyl	Yellowish green
Oriental topaz	Yellow
Oriental cat's-eye	Smoky
Oriental moonstone	Pearly

An attempt has been made to represent these varieties in colour on Pl. 5, 6, and 7, which show both rough sapphires, corundum, and cut specimens.

The lustre of clear stones is almost adamantine, but in the coarser translucent varieties it is opalescent, bronze, milky, pearly, silky, and smoky. Opaque varieties are usually black, but sometimes brownish-black, dark blue, light blue, and greyish white. No instance was observed of the corundum being opaque green.

Sometimes transparent stones have become opaque by the infiltration of mineral matter along fractures and cleavage planes, and transparent stones are occasionally coloured blood-red in a fracture in the interior by the deposition of a fine film of hematite. When viewed through the film the stone appears of a brilliant red colour, but when looked at side ways, it is not apparent, or only a thin dark streak observable. The presence of this film in, say, a green stone would give a red colour in one direction, while in the other direction the green colour would be observed. One of the miners who had been reading something about sapphires had observed this, and stated that "this was a remarkable instance of dichroism in sapphires." One specimen showing this red central spot is represented on Pl. 6, Fig. 16.

In the deeper coloured sapphires the pleochroism is very marked, but in some of the light yellow and green varieties it is hardly noticeable. In the blue stones the *face-colour* in the direction of the *optic axis* differs very considerably from that at right angles with this axis, a property which has to be considered in the cutting of the stones as gems.

In the Anakie blue sapphires, if the table of the gemstone is cut at right angles with the optic axis, the colour obtained will be a blue face-colour, but if the table is cut parallel with the optic axis, instead of getting the face-colour of the crystal in that direction, that obtained is broken up into what appears to be two axis colours by the prisms formed in the angles between the facets of the stone. As the optic axis is perpendicular to the basal cleavage plane, a stone cut parallel to this plane will show a blue colour, but if cut at an angle with this cleavage plane the nearer it approaches a right angle the greater will be the confusion of both blue and green colours. These effects are illustrated on Pl. 4, and show that blue stones of apparently one shade, when looked at in the direction of the principal axis, may have variations in the colour at right angles with this direction. The effects of cutting such stones in the right direction are shown, and also the effects when cut incorrectly. From this plate it will also be seen that as the face colours of the prism become lighter, the axis colours show less green—a condition which will produce a bright blue when the table is cut parallel to the basal cleavage.

If the face colour of the prism is very dark, even with a bright blue on the basal plane, then when the stone is cut with the table parallel with the basal cleavage the bright blue becomes either a very deep blue or blue-black.

When the table is made at right angles with the basal cleavage plane, even though the stone is nearly colourless in this direction, the blue in the direction of the basal plane will have a darkening effect and the gem will show a confusion of colours. *Therefore, when the basal cleavage plane is made the "table" of the gemstone, the less the colour on the "side" of a crystal the brighter will the "top" colour be after cutting, and the more perfect the gem.*

In green sapphires the face colours are different, and the contrast in the axis-colours is not so marked. In yellow stones there is no appreciable difference in the face colours in either direction, so that so far as colour is concerned no special care is necessary in cutting.

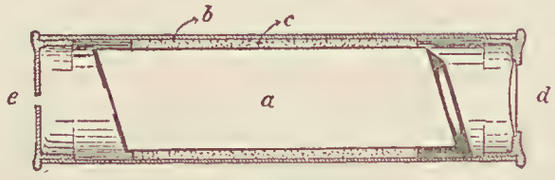
As the question of colour, however, is generally an important one in the cutting of gemstones, a means of recognising the basal plane, when the cleavage is obscure, will be useful to the lapidary, and this is afforded by the *dicroscope*.

Descriptions of this little instrument have been frequently published. A simply constructed dicroscope is made of a cleavage prism of Iceland Spar mounted in a tube, on one end of which is placed a lens, the other end having a small aperture. The spar should be at least an inch long and about $\frac{3}{8}$-inch in diameter, each cleavage end of which, without polishing, is finished by cementing on to it, with Canada balsam, a microscopic cover-glass.

The prism must be painted dead-black, mounted in pieces of cork and pushed into the tube without the addition of other prisms. The tube should be about two and a-half inches long and about half an inch in diameter. On one end is mounted a lens of about three inches focus, to allow the specimen examined to be held in the fingers about half an inch away from the aperture, which is about one-sixteenth of an inch or less in diameter. The end of the prism next to the aperture should be all coated black except a small portion in the centre of about three-sixteenths of an inch in diameter, while the other end, near the lens, should be blackened except a centre of about three-eighths of an inch in diameter.

The following sketch will show the instruments as described:—

Fig. 11.



Dicroscope.

a. Iceland Spar. *b.* Tube. *c.* Cork Mounting. *d.* Lens, about three-inch focus. *e.* Aperture.

With this instrument the lapidary can determine the direction of the optic axis of a sapphire by observing, in transmitted light, the position in which the two coloured spots (the double image of the aperture) show no difference of tint when the instrument is rotated between the eye and the specimen under examination. As the basal cleavage plane is at right angles with the optic axis, the portion of the crystal which shows no change of colour, or any other portion parallel to it, should be made the table of the stone.

The rhombohedral cleavage is occasionally present in sapphire crystals, and might be mistaken for the basal cleavage by the gem-cutter, and as the stone should not be cut with the table parallel with the rhombohedral cleavage, the dicroscope can be made use of to determine whether a cleavage face is rhombohedral or basal.

The dicroscope also is used in the discrimination between true sapphires or rubies and imitation stones, as well as for other purposes which need not be mentioned here. Artificial stones show no change of tint with the instrument, no matter in what position they are examined—they are not *pleochroic*.

(*b*) Zircons.

Hyacinth, the variety of zircon, occurs with the sapphires in the alluvial deposits on all the fields. Usually it is found as small grains, of shades varying from brown to deep blood-red, and rarely in crystals sufficiently large or clear enough to be cut as gemstones. The smoky variety of zircon is unknown on the field.

The small colourless zircons found below the basalt at the old Basalt Hill Diggings and Policeman's Knob, previously referred to, have a resemblance to rough diamonds, and have been mistaken for such. They have rounded faces, are brightly polished, and have a brilliant lustre; but their hardness, which is inferior to sapphire, betrays them at once.

The hyacinth in some of its richer shades is very beautiful, and, although softer than sapphires, are much harder than the opal—the so much prized Australian gemstone. Perfect specimens are very rare, but one weighing over an ounce, after the removal of inferior portions, cut into a gem stone weighing fifteen carats. This is shown on Pl. 5, Fig. 7.

The property of altering its colour is noticeable in some of the Anakie hyacinths. Sometimes the colour is changed by the temperature of the body, this having happened with miners who have carried the stones about with them in their pockets. By gradually heating the stone a portion of the colouring is destroyed, so that a stone too deeply coloured for a gem may be made sufficiently light by this means. The heating of the stone sometimes lessens only the depth of the colour, but it will usually alter the colour from red to brown. Heating intensely will destroy all the colour. Slightly heating will sometimes increase the brilliancy of the colour, which returns to its former tint as soon as the stone becomes cold. Should the stone be heated too much it loses this property, and the colour is permanently destroyed.

Exposure to bright sunlight also changes the colour, but experiments have shown that the original colour returns afterwards. One specimen which had been made colourless by heating became slightly coloured by exposure to light. Specimens, however, which have been exposed and subjected to a certain amount of heating at the hands of the lapidary, in cementing them to the holders for the purpose of grinding and polishing, do not appear to lose their colour under ordinary conditions.

The specific gravity of a number of cut and uncut specimens of hyacinth has been determined, and varies between 4·696 and 4·699, the mean being 4·698.

Pleochroism was only observed in a few thick specimens. The change of colour is slight, and in sections cut for microscopic work is not discernible.

Corrosion of the zircons has previously been referred to. An example is shown on Pl. 3, Fig 5.

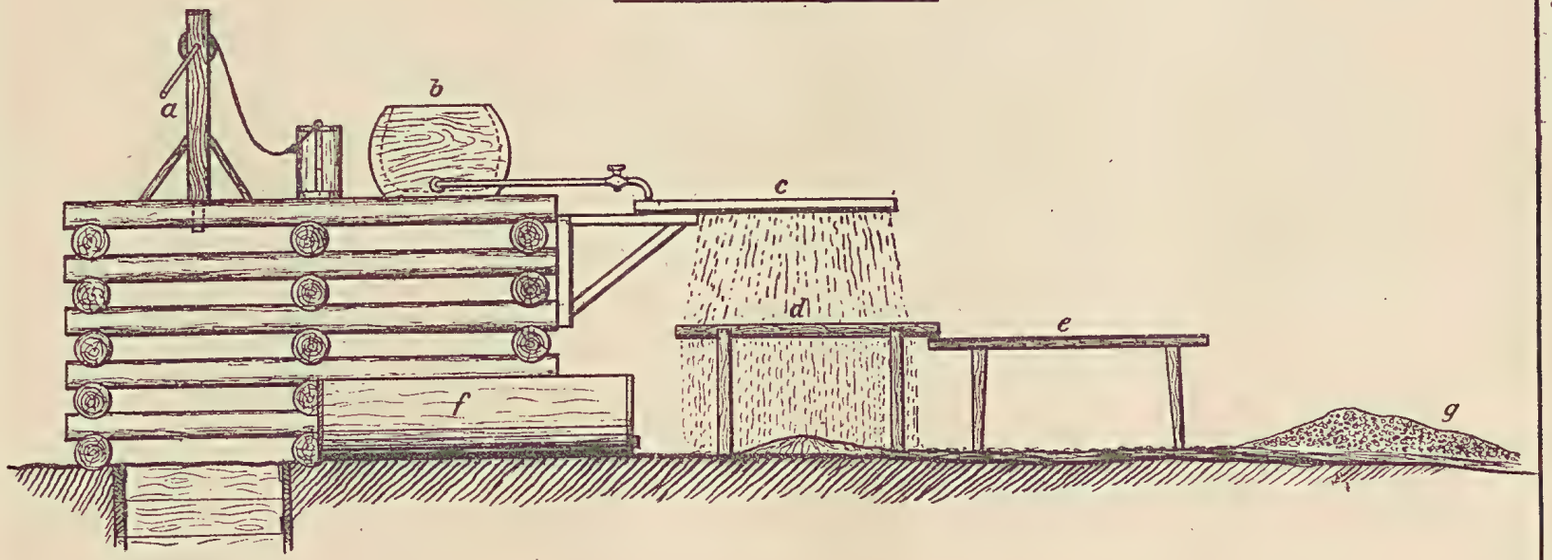
(*c*) Pleonaste.

This black variety of spinel is found in great abundance wherever the sapphires occur, and although usually occurring as small grains it is also found in pieces of about an ounce or more in weight. It was observed embedded in the basalts of Policeman Knob, Basalt Hill, Mount Hoy, Mount Newsome and Mount Leura, reference to which has previously been made.

SAPPHIRE WASHING PLANT
at
Policeman Creek

Scale of feet

0 1 2 3 4 5 6



Specimens showing the crystalline form are rare, as they have been subjected to corrosion by the basalt, but Pl. 2, Figs. 2, 2*a*, 7, 7*a*, show two crystals whose outline has been preserved. Corrosion effects are common, of which Pl. 2, Fig. 1, and Pl. 3, Figs. 1, 8 are illustrations.

The mineral invariably is opaque-black, has a conchoidal fracture and a glassy lustre. Frequently it is mistaken for corundum by miners, but corundum has a cleavage, and has a lustre on a basal cleavage plane different to the other part of the crystal, and is much superior in hardness, so no difficulty should be experinced, even without other tests, in distinguishing the two minerals. The red variety of spinel—spinel ruby—occurs in some of the fields, but only three small indifferent specimens were observed.

8.—MINERAL CORROSION BY BASALT MAGMA.

The corrosion of corundum and pleonaste in the basalt has been referred to previously. The specimens of sapphires found in the cap of Mount Hoy show traces of corrosion but none of erosion. Where the sapphire inclusions are in contact with the enclosing basalt, a film has been formed, and portions of this remain adhering to the specimen as a black scaly coating.

In the alluvial deposits sapphires are found showing the effects of corrosion. The broken portion of the crystal in Pl. 1, Fig. 2, shows corrosion marks, and Pl. 1, Figs. 4, 6, are illustrations of the surfaces, other crystals of sapphires showing similar effects.

With pleonaste the effects are more marked. Rarely has the crystal a polished face or sharp angle, while the pitting of the surfaces with holes is quite common. On Mount Leura every block of basalt shows pieces of pleonaste on its surface, either as rounded scaly blebs (Pl. 3, Figs. 3, 4), as irregular pitted grains (Pl. 3, Fig. 8), or as crystals whose outlines are reduced to skeletons (Pl. 3, Fig. 1). Occasionally the crystalline form of the pleonaste has been preserved with only sufficient corrosion to dull its surface. An example of this is shown in Pl. 2, Figs. 7, 7*a*.

Other corroded mineral inclusions in the basalt of Mount Leura are illmenite, of which Pl. 3, Fig. 2, represents a crystal; plagioclase, a section of which is shown in Pl. 3, Fig. 9; hornblende (Pl. 3, Fig. 7), quartz, and olivine. On Mount Hoy similar corroded inclusions are to be observed in abundance.

From the irregularity of the surfaces of some of the sapphire crystals and other minerals it was thought that they may have been allotriomorphic forms. Some crystals have peculiarities which rather bear this out, in showing the form of the crystal to have been modified by some other mineral at the time of its crystallization, but the preponderance of evidence points to corrosion as the cause of the markings.

9.—THE DISCOVERY OF A DIAMOND AT POLICEMAN CREEK.

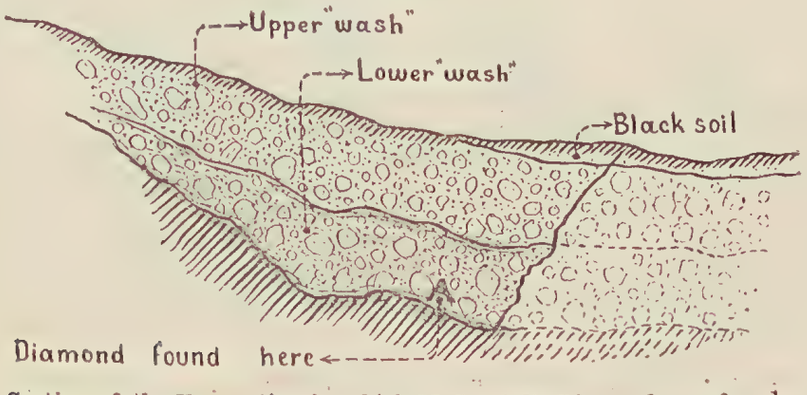
The discovery of a diamond in the sapphire wash was the result of an investigation as to what the miners forwarded to the gem dealers as "white sapphires." Many of the miners have made it a practice to "salt" parcels of sapphires with colourless stones which they considered to be of little or no value. They found out that the buyers "did not object as long as there were not too many, and if of good quality and shape, and were placed amongst the second-class stones," so the practice continued.

Seeking information from the miners as to what stones they were getting was not successful at first, as they thought no good motive instigated the inquiry. Being satisfied on this point subsequently, samples of all the kinds of stones were submitted for examination.

Mr. McCrystal and party, working on their claim on the south side of Policeman Creek, having sent a parcel of stones away to a dealer, kept back a few of the doubtful ones for the writer's inspection, and amongst these the diamond was found. The party placed no particular value on it, further than that it might have as a "white sapphire," and think other similar stones were sent away in previous parcels. Special care, however, will be taken by the miners in future not to send away any more of these "white sapphires" as "second-grade stones."

The locality at which the diamond was found is marked on Map 2, being near the western extremity of a belt of wash on the south side of Policeman Creek. The sapphire wash on the claim consists of two layers, the top one being loose and easily worked, the bottom one of a clayey nature and on that account very troublesome to take out. It is in the clayey bottom wash that the diamond was found, and associated with it were blue and green sapphires, coarse corundum, pleonaste, zircon, quartz pebbles, "billy," and other *débris*. Fig. 12 represents a section of the deposit where the diamond was found.

Fig. 12.



Section of the Excavation in which McCrystal's Diamond was found.

South of Policeman Creek.

The form of the diamond is a combination of the octohedron, triakis octohedron, and hexakis octohedron, as shown on Pl. 2, Fig. 10. The general appearance suggests rounded faces, but this is the result of the oscillation or alternate development of the abovementioned forms of faces. The specimen is perfectly colourless, without a flaw, and weighs one and a-quarter carats. Since the finding of this specimen two others have been unearthed, it is said, near Retreat Creek.

The finding of diamonds at Anakie is the first instance of these stones being recognised in Central Queensland.

10.—LIST OF MINERALS FOUND IN THE SAPPHIRE DEPOSITS.

Corundum varieties—
- Sapphire (blue)
- Oriental ruby (red)
- Oriental topaz (yellow)
- Oriental peridot (green)
- Oriental chrysoberyl (yellowish green)
- Oriental amethyst (purple)
- Cat's eye (smoky, &c.)
- Oriental Moonstone (pearly)

Spinel varieties—
- Spinel ruby
- Pleonaste

Garnet—pyrope

Zircon varieties—
- jargoon (white and yellow)
- hyacinth (brown and red)

Quartz varieties—
- rock crystal (colourless)
- amethyst (purple)
- cairngorm (smoky)

Chalcedony varieties—
- carnelian (red and yellow)

Jasper varieties—
- black (lydianstone), red, brown

Rutile—(in quartz pebbles)

Topaz (white)

Diamond

Magnetite

Titanic iron

Magnesite

Tourmaline

Hornblende.

11.—HINTS TO SAPPHIRE MINERS.

(*a*) Hardness of Minerals.

The test of hardness is not properly understood by many of the miners. In comparing the hardness of an unknown mineral with that of a known one, the tests should be made on sharp edges and clean perfect faces, otherwise the result will not be reliable. As all the gemstones have a hardness above that of a good knife blade, anything below this can be discarded, and with pieces of rock crystal (7), zircon ($7\frac{1}{2}$), pleonaste (8), and corundum (9), all necessary tests can be made.

(*b*) Standard Weights.

As a misunderstanding frequently arises between the gem-miner and the dealer with regard to the weight of stones, the following table might prove useful:—

Gem Weights.

1 troy oz. =	24 dwt. =	$151\frac{2}{3}$ carats =	480 troy grains.
	1 dwt. =	$7\frac{1}{2}$ carats =	24 troy grains.
		1 carat =	3·17 troy grains (or 4 diamond grains).

The parts of a carat are expressed in sub-multiples of 4, as $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{64}$.

(*c*) Mineralogical Testing of Gemstones.

A small text-book on mineralogy will also be useful to those interested in sapphire-mining, so that tests of colour, lustre, form, fracture, cleavage, hardness, and other properties can be applied to the stones. With a set of blowpipe appliances additional tests may be made. "Gems and Precious Stones," by H. G. Smith, Mineralogist to the Technological Museum, Sydney, is the title of a book specially adapted for Australian readers.

12.—HISTORICAL NOTES.

Inquires have been made regarding the discovery of sapphires in the Anakie District, and the subsequent development of the deposits containing them. It seems that at about the year 1875 Mr. Richardson, a railway surveyor, found some red zircons on Retreat Creek and sent them away to be tested, thinking they might be rubies, but the sapphires which were present with them failed to attract his attention.

In April, 1876, John Evans, who was a prospector for gold, reported that sapphires occurred in a gully and on a ridge near Retreat Creek. The position is 150 yards from the house on the freehold block, on the north side of the creek, now the property of the Withersfield Sapphire Syndicate. Mr. Dobson, an old resident of Retreat Creek, states that Mr. Evans also found at about the same time sapphires at the foot of a tree near the Old Basalt Hill auriferous workings.

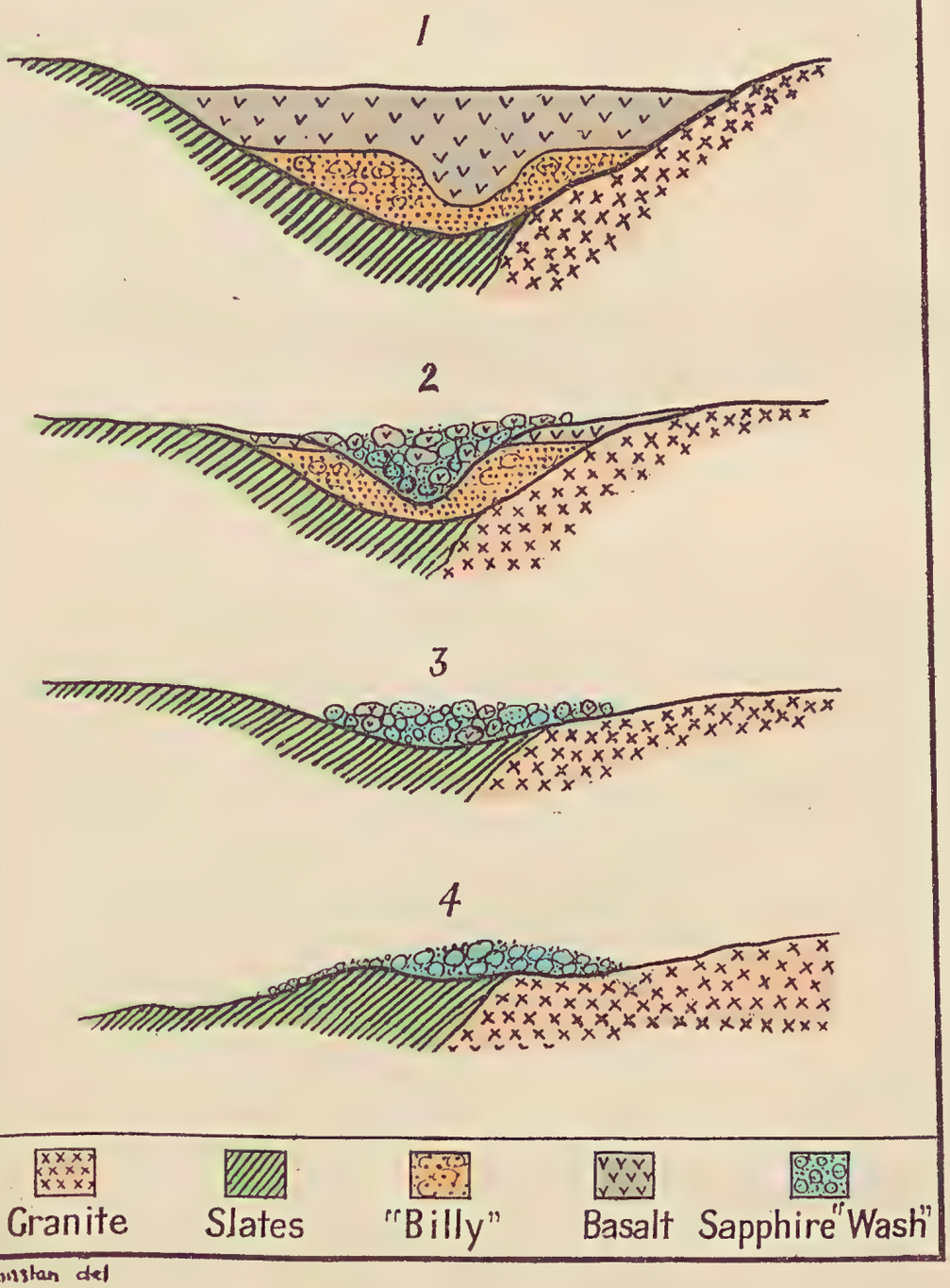
In 1881, Mr. Blair, manager for Mr. Richardson, opened up the deposits where Evans found the sapphires on Retreat Creek, and in 1890 Mr. Fisher became a partner of Mr. Richardson in the sapphire-mining operations. In 1891 Mr. Ballard took up an area of ground next to that of Richardson and Fisher's, and this ultimately became the property of the Withersfield Sapphire Company, of which Mr. Spier and Dr. Stuart were the principals. In 1892 Messrs. Duke and Newsome each took up areas of sapphire-bearing ground, and later on operations were started by the Oriental Sapphire Company, and by the Withersfield Sapphire Syndicate in 1900, with Mr. Spier as managing director. Messrs. Richardson, Fisher, Spier, Newsome, Logan, and Dr. Stuart have each thrown a lot of energy into the sapphire work and otherwise assisted in pioneering the industry and in drawing the attention of gem dealers to the rich quality of the stones.

At the beginning of operations in sapphire mining very few men were engaged, but at present there is a permanent population of about 200 individuals on the fields.

DIAGRAM

in illustration of

the Formation of the Anakie Sapphire Deposits



W. Dunstan del

13.—NOTES ON FOREIGN SAPPHIRE MINES.

Of the many localities where sapphires occur in other parts of the world, those of Ceylon, Cashmere, Upper Burma, Siam, and Montana are the most important.

In *Ceylon* the sapphires are found in both old and recently formed river gravels, in association with other gemstones. They occur at depths varying to twenty feet below the surface, but usually are found much shallower. The colours are blue, of many shades between dark and very pale blue. White and yellow stones are also present, but rare.

At *Cashmere* the sapphires occur high up in the Himalaya Mountains, in a garnetiferous gneiss and crystalline limestone. These matrices are decomposed on the surface, and the sapphires can be easily extracted from them, but, where the rocks are hard, great care and trouble are necessary in their extraction. The shades of colour are mostly in blues and bluish-greys, and rarely yellow, red and brown, while a great proportion of these are either "milky" or "silky."

In *Upper Burma* the stones are found in a river gravel, in surface soil, and *in situ* in crystalline limestone. The gravel and soil deposits have been derived from the limestone, but it is in the gravels that the more important mines are situated. The colours are white, blue, yellow, and red, and some of these are opalescent, the blues and reds being the more common. The blues, generally, are larger stones than the reds, but are inferior to them in quality.

The *Siam* mines produce the finest blue sapphires in the world. The stones are in a clayey gravel a few feet in thickness, and occur about two feet below the surface. The colours are red and blue of varying shades. Most of the small stones (one carat and under) are inferior in colour, while the large stones are generally perfect.

In America, before the Montana deposits were discovered, the stones produced were of bluish-green and yellow tints, and "although immense quantities of these stones are obtainable they are of small commercial value on account of their unmarketable colour." At Yogo, Fergus Co., Montana, a dyke rock is the matrix of the sapphires. They were first found in some auriferous gravels which form terraces above the present river bed, but later on they were discovered in a decomposed dyke rock between walls of limestone. This decomposed dyke rock has since been traced along the surface for a distance of five miles. In depth the rock is undecomposed and compact, and is found to consist of brown mica and plagioclase, being a variety of lamprophyre. The colours of the Montana sapphires are shades of blue, bluish-green, light green, yellow, and red, and some of the blues are said to approach the standard of colour known as "cornflower" blue. The only mineral associated with the sapphires is iron pyrites, which occurs in the form of grains.

Siam sapphires may be taken as the type of "cornflower" blues, compared to which Burma stones may be generally considered too dark, Ceylon stones too light, and Cashmere stones too milky. Each of these localities, however, produce good blues, but in all of them the light green and yellowish green stones, of which the Anakie miners are so proud, are exceedingly rare.

14.—CONCLUSION.

In the preceding pages no reference has been made to the value of the yields of sapphires obtained by the Anakie miners. Under the best conditions of any gem industry there is a considerable fluctuation in the value of the stones, and this is more noticeable where the industry is a young one, and where the stones have not become "standardised." With the Anakie stones, therefore, any estimate of value to be reliable must be based on absolute returns, but as such returns are not available, although those interested have had no hesitation in giving information about quantities and qualities, the estimate of absolute values must be left a blank.

An approximate estimate, however, has been prepared by one who has a knowledge of the Anakie sapphire trade, and shows that up to the time of the inspection about £5,000 worth of sapphires have been sold to English, American, Continental, and Intercolonial dealers. This estimate seems to be a very low one, as within the last twelve months there has been, on an average, about 100 miners on the field, who must be earning enough to keep them in rations, &c. As the cost of rations would be about 10s. per week, there would be a total distribution amongst the miners, on this basis alone, of about £2,500 a year, and this is half the total estimated value of the gems obtained during the whole time the mines have been opened. Probably a more accurate estimate of the value received by the miners from the stones sent away from the fields would be £10,000.

In sapphire mining a parallel may be drawn with ordinary auriferous alluvial deposits, where one claim might be yielding handsome returns while the adjoining one is not even payable—an ordinary experience in both classes of mining. With sapphire mining one man is doing well when he is obtaining, perhaps, two or four ounces of mixed stones per day, another just making a living at one ounce per day, while a third miner not getting more than half-an-ounce will find in this a few stones weighing a couple of pennyweights worth more than the whole of another man's four ounces. On one claim, perhaps, a man will obtain very few stones and of no value, and when on the point of abandoning it finds, it may be, a stone worth £20 or £30, or at the beginning of his work a miner may find a valuable stone and, under what might appear favourable conditions, spend considerable time looking for more without success. As with alluvial gold mining, some will consider its prospects very good because they obtain good results, while other miners, less fortunate, will look upon the industry with disfavour.

One marked difference exists, however, between the two classes of mining in that gold has a standard value and a gold-miner knows the value of his yield as soon as it is weighed, while a sapphire miner after finding his sapphires has to obtain a market for them, and having obtained a market he will only know the result of the transaction perhaps months after the stones have passed out of his possession.

Dr. Jack, in the report previously quoted, has estimated the returns from some of the mines. He states that from a ton and a-half of washdirt he obtained "254 sapphires of from 3 to 179 carats each, and weighing in all 3,289 carats," but during the present inspection such results were not obtained, half these quantities being about the maximum.

Regarding the prospects of the field, there is no doubt whatever in stating that they present a most favourable aspect. Miners are always arriving on the fields, discoveries of sapphire country are constantly being reported, and, what is perhaps of more importance, there is an ever increasing demand for the stones. Although fresh discoveries of sapphire country are being made, yet the western fields of Tomahawk and Central Creeks, where the most extensive areas exist, have not been prospected to any extent. Natural conditions here are unfavourable, and because of the undeveloped state of the country, progress is greatly impeded. The country is badly watered, a great inconvenience to prospectors both in getting to the fields and afterwards in exploring them, and the distance from Anakie, the source of supplies, is too far for prospectors to take rations unless they are provided with horses, a provision which is out of the question with most of them.

Although the existence of the industry in the past has depended entirely on the individual perseverence of those who are or have been engaged in it, yet it should receive more attention from those interested in the gem industry, and more encouragement from those interested in the development of our mineral resources.

15.—DESCRIPTION OF PLATES.

Plate 1.

Corundum crystals showing form, cleavage, and corrosion marks.

Figs. 1, 1*a*.—A waterworn crystal of corundum exhibiting both basal and rhombohedral cleavages. Fig. 1*a* is a section of the crystal along the line A.B.

x 1¼ size. *Loc.*, Newsome's Claim, Retreat Creek.

Fig. 2.—A crystal of corundum with rounded edges and faces, showing on its fractured surfaces the effects of both corrosion and erosion. A small crystal has been attached to the side of the larger one.

1¼ size. *Loc.*, Newsome's Claim, Retreat Creek.

Fig. 3.—Diagram illustrating the general appearance of the rhombohedral cleavages where they intersect a basal section. The arrows indicate the direction of inclination of the cleavage planes.

Fig. 4.—Natural surface of portion of sapphire showing corrosion. The markings are more granular than those in Fig. 6, and suggest being formed on faces rather than on the edges of cleavage planes.

Nat. size. *Loc.*, Tomahawk Creek.

Fig. 5.—Corundum crystal. On the basal plane (*b*) a rhombohedral development (*a*) has taken place. The shaded portions (*c*, *cc*) represent what appears to be indistinct prismatic and pyramidal faces.

Nat. size. *Loc.*, Tomahawk Creek.

Fig. 6.—Natural surface of portion of sapphire showing corrosion markings. The markings are elongated and seem to have been formed along the edges of cleavage planes.

x 1½. *Loc.*, Tomahawk Creek.

Plate 2.

Structures in corundum and "billy" and forms of pleonaste and diamond.

Fig. 1.—A fragment of corroded pleonaste. The surface is marked with small circular depressions.

Nat. size. *Loc.*, Newsome's Claim, Retreat Creek.

Figs. 2, 2*a*.—Two views of a crystal of pleonaste. The faces are curved, slightly distorted, and are covered with minute etchings.

x ½. *Loc.*, Mount Leura.

Figs. 3, 3*a*.—Two views of a blue and yellow sapphire crystal, showing pyramid (*a*) and prism (*b*) of second order, and two rhombohedrons of the first order. One rhombohedron is obtuse (*c*), the other very acute, and forming a yellow core inside (*c*). The basal terminal plane (*d*) forms the end of the acute rhombohedron, their edges coinciding.

Forms :—(11$\bar{2}$1), mP2 (*a*); (11$\bar{2}$0), ∞P2 (*b*); (10$\bar{1}$1), R (*c*); (0001), OP (*d*).

x ½. *Loc.*, McCrystal's Claim, Policeman Creek.

Figs. 4, 4*a*.—Fig. 4 represents a polished basal section of corundum, and shows a small internal prism of the second order, and rhombohedral cleavages. The cleavages also appear to penetrate the small crystal, although, as shown in Fig. 4*a*, this might result from the building up of the crystal in a series of flat superimposed individuals between which some films of the larger crystal are formed as alternations.

x 6. *Loc.*, McRichie's Claim, Retreat Creek.

Fig. 5.—Another polished basal section of corundum, showing a marked development of one set of rhombohedral cleavages.

x 1½. *Loc.*, Newsome's Claim, Retreat Creek.

Fig. 6.—Basal section of portion of corundum showing prismatic zonal lines and rhombohedral cleavage lines, and producing a "sagenitic" structure.

x 2. *Loc.*, Newsome's Claim, Retreat Creek.

Figs. 7, 7*a*.—Two views of a distorted crystal of pleonaste. On one abnormally developed face there is a group of three faces of the triakis octohedron. On other portions of the crystal, these faces are indicated by fine lines bordering the octohedral faces.

Nat. size. *Loc.*, Godlipp's Claim, Retreat Creek.

Figs. 8, 9.—Sections of quartz grains in enclosed pebbles in the altered rock "billy." A second growth of the quartz has taken place from the surface of the pebbles, showing no line of break between the interior (old) and exterior (new) portions, and both having the same optic orientation.

Slide 12. x 50 *dia.* *Loc.*, W.S.S. Reward Claim, Sheep Station Creek.

Fig. 10.—McCrystal's diamond. The traces of the octohedron, triakis octohedron, and hexakis octohedron, are distinctly seen. In the drawing the crystals appear too prominently rounded.

Loc., McCrystal's Claim, Policeman Creek.

Plate 3.

Inclusions in basalt—macroscopic and microscopic.

Fig. 1.—Crystal of pleonaste partly destroyed by corrosion. Imbedded in basalt.
x ¾. *Loc.*, Mount Leura.

Fig. 2.—Corroded crystal of ilmenite (titanic iron), imbedded in basalt.
x ¾. *Loc.*, Mount Leura.

Fig. 3.—Bleb of pleonaste in basalt, naturally weathered.
x ¾. *Loc.*, Mount Hoy.

Fig. 4.—Bleb of pleonaste with bright surfaces, weathered out of basalt.
x ¾. *Loc.*, Mount Newsome.

Fig. 5.—Crystal of zircon (var. hyacinth), showing corrosion marks. The countersunk portions have bright surfaces, while the elevated portions are dulled by subsequent abrasion.
x ¾. *Loc.*, McCabe's Claim, Retreat Creek.

Fig. 6.—Portion of weathered granite fragment showing idiomorphic tourmaline (*b*), in quartz (*c*), both in the interstices between crystals of orthoclase. (*c*)
x ¾. *Loc.*, base of Mount Leura.

Fig. 7.—Inclusion of hornblende and plagioclase in basalt. Severe corrosion has taken place on the edges.
Nat. size. *Loc.*, Policeman Creek.

Fig. 8.—Fragment of pleonaste corroded to a spongy mass.
x ¾. *Loc.*, Mount Leura.

Fig. 9.—Portion of plagioclase inclusion in basalt. A kaolinised film exists between the mineral and the rock.
x ¾. *Loc.*, Mount Leura.

Fig. 10.—Crystal of augite in basalt, exhibiting corrosion, internal alteration, and an external zone free from alteration or inclusions.
Slide 7. x 15. *Loc.*, Mount Leura.

Fig. 11.—Section of basalt showing the formation of laths of felspar around a bleb of pleonaste.
Page. x 15. *Loc.*, Mount Hoy.

Fig. 12.—A rounded bleb of olivine in quartz. Olivine (*a*), magnetite (*b*), plagioclase (*c*), augite (*d*).
Slide 6. x 15. *Loc.*, Mount Newsome.

Plate 4.

Diagram showing the effect of pleochroism in the cutting of Anakie blue sapphires.

Fig. 1.—Colour of the sapphire observed in the direction of the principal axis—*i.e.*, observed at right angles with the basal cleavage.

Figs. 2 to 5.—Colours of different crystals observed at right angles with the principal axis.

Figs. 6 to 9.—Colour effects when the "table" of the stone is at right angles with the principal axis—*i.e.*, parallel with the basal cleavage.

Figs. 10 to 13.—Colour effects of the "table" when cut parallel with the principal axis—*i.e.*, across the basal cleavage.

A stone with the blue colour (1) on the basal cleavage plane, and with the pale green (5) at right angles with it, will produce the colour (9) if cut correctly, but if cut otherwise—at right angles with the cleavage—it will be dichroic, showing a confusion of the two colours (1) and (5), but with increased depth, as in (13).

Another example: With the same, or nearly the same blue colour (1) on the "top" or cleavage plane and the colour (2) on the "side," effects are produced as in (6) and (10) according as the table is made on the "top" or "side" respectively. In this example, a fine blue stone as seen in one direction, and a decided green in the other direction, when cut either way would produce a dark and almost useless gem.

Plate 5.

Illustrations of Cut Gemstones.

(All the figures represent corundum varieties except Fig. 7, this being a hyacinth.)

Figs. 3 and 8 are pure blues of two shades, rare colours in Anakie sapphires.

Figs. 1, 4, and 12 are greens of the oriental peridot type.

Figs. 5 and 9 represent yellowish green stones of the oriental chrysoberyl type.

Figs. 6 and 13 exhibit two shades of oriental topaz, one, Fig. 6, being canary yellow, the other, Fig. 13, an amber yellow.

Figs. 2 and 11 represent two cat's-eyes, Fig. 2 being of a greyish tint; Fig. 11 a bluish white.

Fig. 7.—Represents a dark-red hyacinth. Some stones vary considerably from this in being lighter in tint and also in having more brown mixed with the red.

Plate 6.

Corundum Crystals.

(All natural size.)

Fig. 1.—Smoky, barrel-shaped crystal, showing traces of rhombohedral cleavages.
Loc., Newsome's Claim.

Fig. 2.—Pyramid showing obliteration of two pyramidal faces (reversed in drawing).
Loc., Newsome's Claim.

Fig. 3.—Crystal showing terraced structure resulting from alternate development of faces of prism and basal plane.

Loc., Halliday's Claim, Policeman's Creek.

Fig. 4.—Vertical section (along the principal axis) showing the building up of different coloured corundum.

Loc., Newsome's Claim.

Fig. 5.—Crystal showing zonal bands and a modified "hour glass" structure. The crystal is tabular, the only specimen observed having this character.

Loc., Retreat Creek.

Fig. 6.—An acute rhombohedron of yellowish colour. The trace of another obscure face is also shown.

Loc., Newsome's Claim.

Fig. 7.—An opaque blue and bronze-coloured crystal. The trace of the rhombohedral twinning plane is also shown.

Loc, Andrew's Claim, Retreat Creek.

Fig. 8.—Smoky crystal, showing rhombohedral developments on the basal plane.

Loc., Reward Claim.

Fig. 9.—Six-rayed corundum, with a centre showing hexagonal section. The rhombohedral cleavages are well marked, and there are traces of zonal banding.

Loc., Newsome's Claim.

Fig. 10.—Ruby-coloured semi-opaque crystal of corundum, with traces on the prism faces of blue banding parallel to basal plane.

Loc., Newsome's Claim.

Fig. 11.—Structure similar to that represented in Fig. 3. The development of the terraced structure has been uniformly around the crystal.

Loc., Reward Claim.

Fig. 12.—Pale-blue sapphire, with smoky schiller (?) inclusions along rhombohedral cleavage planes.

Loc., Newsome's Claim.

Fig. 13.—A crystal showing bright-blue, ruby, and purple colours on the basal plane. These colours at right angles with the optic axis are pale green, rose red, and purplish green.

Loc., Newsome's Claim.

Fig. 14.—Basal section showing red centre and semi-opaque blue on the periphery.

Loc., Newsome's Claim.

Fig. 15.—Very pale ruby. Fig. 15 shows the colour on basal plane; Fig. 15*a*, the colour at right angles with it.

Loc., Newsome's Claim.

Fig. 16.—Bluish-green sapphire, coloured blood red by film of hematite in a flaw in the centre.

Loc., Andrew's Claim, Retreat Creek.

Plate 7.

Corundum Crystals.

(All natural size.)

Fig. 1.—Blue sapphire with yellow centre. Basal section. The Yellow triangle is a portion of an acute rhombohedron. No specimen has yet been found having a blue centre with yellow surrounding it.

Loc., Tasmanian's Claim, Retreat Creek.

Fig. 2.—Basal section of blue crystal with ruby bands.

Loc., Newsome's Claim.

Fig. 3.—Green zonal band on blue prism.

Loc., McRichie's Claim, Retreat Creek.

Figs. 4, 5.—Blue basal terminations to dark prisms. In Fig. 4 the blue is at both ends.

Loc., Newsome's Claim (both).

Fig. 6.—Basal section showing three very dark triangles in an opaque corundum crystal. Structure undeterminable.

Loc., Reward Claim.

Fig. 7.—Pyramid of corundum with clear light blue segments alternating with smoky segments parallel with basal plane.

Loc., Hunt's Claim, Retreat Creek.

Fig. 8.—(Blank).

Figs. 9, 9*a*.—Two views of one crystal. A normally developed yellow crystal with a subsequent (?) addition of blue on one of its prism faces.

Loc., Poverty Hill.

Fig. 10.—Section of a yellow di-hexagonal pyramid or prism in a greenish corundum.

Loc., Newsome's Claim, Retreat Creek.

Fig. 11.—Pale-blue crystal with apex of deeper blue.

Loc., Retreat Creek.

Fig. 12.—Yellow rhombohedron enclosed in bluish-green prism. Vertical section.

Loc., Rice's Claim, near Reward Claim.

Fig. 13.—Yellow and brown corundum in alternating bands. Basal section.

Loc., Reward Claim.

Fig. 14.—Partial yellow banding in blue crystal. In one part of the section (basal) the yellow bands have diminished to fine lines.

Loc., Newsome's Claim.

Figs. 15, 15*a*.—Yellow crystal with banded and smoky rhombohedral development. Fig. 15 shows end view. Fig. 15*x* is a vertical tangential section (*see* dotted line on Fig. 15) showing the rhombohedral structure.

Loc., (?)

Fig. 16.—Two views of rather flat crystal showing a yellow band between two others which are smoky-brown. Fig. 16 shows the zonal banding present in the smoky portion, and absent from the yellow.

Loc., Newsome's Claim.

Plate 8.

Sapphire Washing Plant at Policeman's Creek.

a. Windlass.—The supporting logs are lengthened to accommodate the long water-supply trough.

b. The water-supply trough (end view) is made from a hollow log. It supplies the wet-jigger (*d*) and puddling trough (*f*). The pipe and cock shown in the sketch may be replaced by canvas hose, siphon, &c.

c. Sprinkler.—Made of sheet-iron spouting, and perforated according to the supply of water required. The wash might be clayey, necessitating being well washed.

d. The wet-jigger with perforated iron or woven-wire bottom. Size of mesh $\frac{1}{8}$ inch to $\frac{3}{16}$ inch. The motion is a horizontal shaking one of 4-inch throw.

e. Sorting table.—Covered with sheet-iron and placed below the level of the wet-jigger.

f. Puddling trough.—Its use is necessary to remove soft clayey matter and also to wet the wash-dirt before jigging.

g. Tailings.

Working the Plant.

The operation consists in placing the wash-dirt into the puddling trough (*f*), supplying water from the well, working the dirt with a shovel or flat wooden blade, throwing the dirt on to the wet-jigger, and turning on the sprinkler and shaking the jigger for a minute or two.

The finer portions fall through the jigger and are washed away. The coarser portion remaining in the jigger is spread over the sorting table, and the gemstones picked out. The refuse is then thrown on to the tailing heap.

Plate 9.

Diagram in illustration of the formation of the Anakie Sapphire Deposits.

Fig. 1.—This figure shows pre-existing conditions. The sapphire-bearing basalt has overflowed a deposit of altered sandstone ("billy"), the bedrock of which is slate and granite.

Fig. 2.—The next stage shows the partial removal of the basalt and "billy," and the accumulation of *débris* in a channel in which the gemstones are contained.

Fig. 3.—The basalt and "billy" as rock masses have now been entirely removed. The sapphires remain behind with the *débris* on the slate and granite.

Fig. 4.—This figure represents the conditions at the present time. The slates have become decomposed, and, where not protected from rain by the boulders of "billy," have been weathered down, while the sapphire wash, mixed with the "billy" boulders, remains in its original position, but which, instead of being in a depression, now occupies an elevated position.

Plate 10.

Sapphire Washing Plant (Newsome's).

a. Paddock cut out of the side of the bank of Retreat Creek. The dirt is tipped over the top of the bank, and, after a number of loads have accumulated, it is washed in the plant below.

b. Puddling trough where the dirt is puddled or soaked before jigging.

c. Supply tank for trough and jigger.

d. Supply pipe for trough.

e. Wet-jigger (end view).—Its four springs (legs) are fixed to a frame embedded in the ground.

f. Sprinkler, in front of tank (*c*) and above wet-jigger (*e*).

g. Sorting table at the end of jigger.

h. Barrow for removing tailings thrown from the table.

i. Well in bed of Retreat Creek.

j. Iron bucket attached to wire rope passing through pulleys *k* and *kk*, and travelling between two guide wire-ropes fastened to bottom of well.

k. Fixed pulley leading on to movable pulley *kk*.

l. "Circular whip" worked by horse (on the same principle as an alluvial puddling machine). The wire-rope leads from the pulley *kk* to the horizontal beam of the circular whip, and as the horse travels around the path the bucket in the well is lifted. The height of the lift is regulated by the point of attachment of the rope on the beam of the whip, and can be adjusted very accurately.

m. The bucket as it is being emptied at its extreme height. One end of a chain, a few feet in length, is fastened to the lip of the bucket, the other end having a ring attached which slides up and down a third wire-rope as the bucket is elevated or lowered. The position of the chain is also shown when the bucket is in the well. As the bucket rises high enough for emptying, the ring at the bottom end of the chain catches against a stop in the wire-rope and prevents the lip of the bucket rising any higher. The hauling-rope continues a few inches further, and by the pull on the lip the bucket is tilted to one side and the contents emptied into the launder (*n*) which delivers into the tank (*e*).

PLATE 11.

Section of Sapphire Deposits at Retreat Creek.

a. The "top wash."—The material composing this is "billy" basalt, quartz, &c. One boulder to the right of the section shows a very irregular outline, a characteristic form.

b. A clay deposit, forming a false bottom to the wash. It is well defined in places, but absent altogether in others. Sapphires are sometimes found imbedded in it to the depth of a few inches.

c. The "bottom wash." Similar in composition to the upper wash. Several claims were supposed to have been worked out after the upper wash was removed. Later developments show the lower wash to be as good as the top one.

d. The bedrock of slates and schists of various kinds. The lower wash and the surface of the bedrock are sometimes so much alike that a difficulty is frequently experienced in distinguishing the bottom of the alluvial deposits from the top of the decomposed slate.

PLATE 12.

Geological Sections.

Section A to B.—This is taken across Mount Hoy and Mount Leura, and shows the general features of the Drummond Beds, with their conglomerates, the head of the sapphire belt at the base of Mount Hoy, and the granite and isolated basalt peaks towards Mount Leura From such a section it would be more reasonable to suppose the sapphire-bearing basalt came from Mount Hoy with its underlying shales and other rocks, than from Mount Leura, whose base is granite.

Section C to D.—This section is taken across the old basalt workings (Basalt Hill), where the zircons occur in the alluvial deposits below basalt, to Mount Pleasant and Mount Bullock, and thence along the Retreat Creek sapphire deposits. Copper occurs near the junction of the slate and diorite near Mount Pleasant.

[No. 172 of the Geological Survey Publications.]

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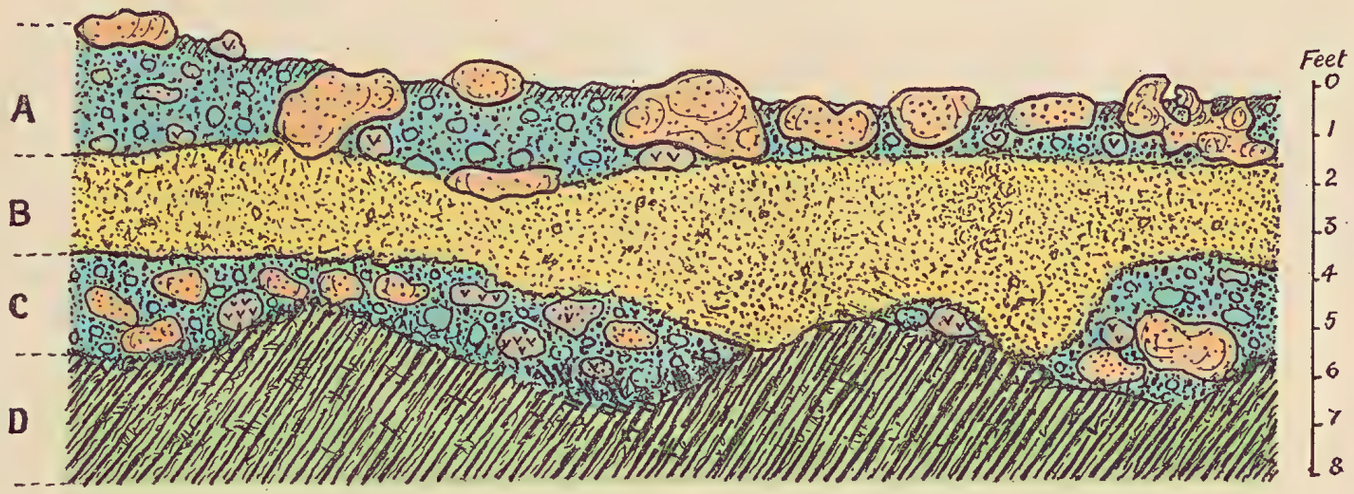
m
k
n
i
Water Level
e
g
h
f
c
d
a
kk
l
SAPPHIRE WASHING PLANT
(Newsome's)
Scale of feet
0 2 6 8 10 12 14
B. Dunstan, del.

MUSEUM
VICTORIA

B. Dunstan del.

SECTION OF SAPPHIRE DEPOSITS AT RETREAT CREEK

Showing two distinct beds of "Wash"



A. Top Wash B. Clay deposit C. Bottom Wash D. Slates, Schists, &c.

GEOLOGICAL SKETCH SECTIONS

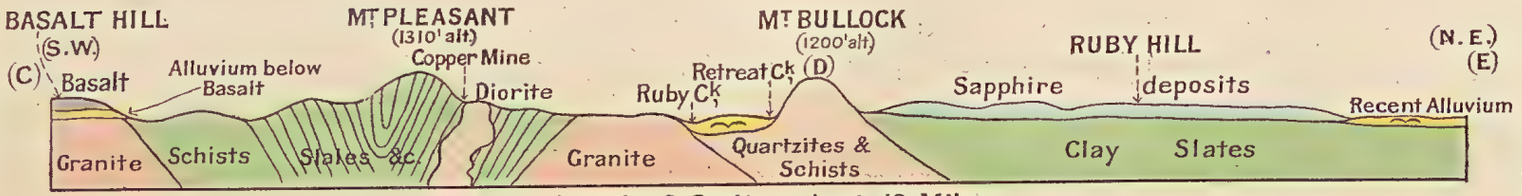
Accompanying Report on the Anakie Sapphire Field

CENTRAL QUEENSLAND

By B. DUNSTAN, F.G.S.

The Sections are along lines shewn on accompanying Geological Map

Length of Section about 10 Miles



Length of Section about 10 Miles

Geological Survey of Queensland

Plate XII

Geological Sketch Map
Shewing some of
ANAKIE SAPPHIRE FIELDS
CENTRAL QUEENSLAND
BY
B. Dunstan
1901
Enlarged portion of Map I

Scale of Miles
0 ½ 1 1½

NOTE.–Geological boundaries only approximately correct

REFERENCE
- Recent Alluvium
- W — Sapphire Deposits
- B — Basalt
- D — Diorite &c.
- F — Slates
- M — Metamorphic Rocks
- G — Granite
- Sy — Syenite

Tempest Workings
Camp
Wells
Workings
White Zircons in Alluvium
POLICEMAN'S KNOB
Pleonaste &c. in Basalt
1 Carat Diamond found here
PROPOSED RESERVE
Policeman Creek
Conglomerates
Workings
ICUANO FLAT
Outcrop of Syenite with Dykes of Hornblende Rock
Small W Sapphires
OLD TELEGRAPH LINE
Dyke of Diorite
Epidote rock with Calcite
Mica Schists &c.
Slates
Reid's Waterholes
Sheep Station Creek
Aplite Dykes in Syenite
Quartz Blows in Quartzites &c.
Slate
Chalcedony Jasper
Workings
RUBY HILL
Workings
Workings
Altered Micaceous Sandstones
Bessie Workings
Micaceous Slate bottom
Hornblende rock on bottom
Newsome's
Quartz Reefs
Limestone
MT. BULLOCK
Slate
Retreat Creek
Gate Creek
3022 80 ac. Freehold
160 ac. Sultana Reward Claim
Small Sapphires
Keilambete Station
Washpool Creek
Tourmaline in Gneiss
Dobson's
Diorite Mass
Hunt's
Ruby Creek
Spring Creek
POVERTY HILL
Limestone Epidote Garnet rock in Dykes
Micaceous Slate
Muscovite Granite
Gate

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1902.

QUEENSLAND.

MOUNT BIGGENDEN GOLD AND BISMUTH MINE AND THE PARADISE GOLD FIELD.

(REPORT ON THE, BY LIONEL C. BALL, B.E., ASSISTANT GOVERNMENT GEOLOGIST.)

[*With* 2 *Maps and* 12 *Plates.*]

Presented to both Houses of Parliament by Command.

THE HONOURABLE THE MINISTER FOR MINES, BRISBANE.

Geological Survey Office,
Brisbane, 4th March, 1902.

Sir,—I have the honour to forward herewith Report on the Mount Biggenden Gold and Bismuth Mine, and on the Paradise Gold Field, with two maps and twelve plates, by Lionel C. Ball.

I have, &c.,
WILLIAM H. RANDS, Government Geologist.

BIGGENDEN GOLD AND BISMUTH MINE.

The Biggenden Mine is situated on one of the minor spurs on the western side of Mount Biggenden, between Biggenden Creek and it tributary Matheson's Creek. It is connected by road with both Degilbo and Biggenden Railway Station, the distance to the former being 4½ miles, to the latter 5 miles.

The company has two adjacent mineral leases (No. 6 of 80 acres, and No. 7 of 10 acres), and a machine area of 5 acres, on Two-mile Oaky Creek. The main open cut is situated in the north-western corner of No. 6 Lease, and is about 125 feet above Biggenden Creek. The brace of the main shaft, which has a depth of 150 feet, is a little over 150 feet above the creek. The mine is thus well situated for preliminary exploitation. Attempts have been made to dam Two-mile Oaky and also Biggenden Creek, but with only partial success owing to the porous nature of the decomposed granite.

On all sides of the Biggenden Mine are steep hills, which, within a mile to the north-east, give place to gently rolling country, extending from a point south-east of Mount Biggenden northwards to the railway line, and beyond it on to the Stanton Harcourt Diggings. Westwards these rolling lands are found almost to the Chowey Reefs.

The area included between Paradise, the Stanton Harcourt Diggings, Mount Hastings Mine, and the Chowey Reefs, which includes Mounts Biggenden and Shamrock, has a base of palæozoic slates, which have not, however, been proved to be all of one age. At Watson's Quarries, between Biggenden and Degilbo Railway Stations, the limestones carry undoubted Permo-Carboniferous Fossils; for example—Stenopora crinita, very abundant; S. australis, scarce; casts of a few Gasteropods; casts of Lamellibranchs; Crinoid stem-joints, plentiful; Protoretepora, abundant, with other Fenestellidæ; Cyathophylloid (?) corals. Sections have not been made of these. Green tuffaceous beds, consisting in great part of silicate of iron, occur with these limestones, and have been exposed in the railway cutting 2 miles west of the Biggenden Railway Station.

It is probable that the strata at Mount Biggenden are of the same age as the above, the tuffs being represented by epidote-actinolite—"augen" slates and scorodite rock. It will be noticed, on the map appended, that there are numerous outcrops of limestone between Mounts Hastings and Havilah. These are crystalline and unfossiliferous. They usually continue for a few yards only, and often the calcite passes gradually into slate, as is to be expected from the impure nature of the limestones in Watson's Quarries.

Over much of the area considered are tracts of red soil, formed by the decomposition of volcanic rocks (chiefly andesite), much of which will probably be proved to consist of contemporaneous sheets in the Permo-Carboniferous Beds. Though rather sticky, this is a first-class agricultural soil, in strong contrast to most of that formed by the slates and granites.

Granites are found in the slates at several places on the periphery of the area—viz., at Paradise, Stanton Harcourt Diggings, Woowoonga Creek, Mounts Hastings, Biggenden, and Havilah, and at the Chowey Reefs, at each of which ore deposits have been worked.

The map (No. 1) shows that the junction of slates and granites passes just to the west of Mount Hastings, the Biggenden Mine, the Don Jon Workings, and Mount Havilah, where the ore deposits are in the slates within a few chains of the junction.

The granite is proved to be intrusive by a dyke at the Biggenden Mine Dam and by its general outline near the mine. At Mount Hastings the granite cuts across the upturned edges of the slates. The rock appears to be normal in composition, consisting of pink orthoclase, quartz, and biotite, the last giving the rock a prevailing grey tint. Everywhere the granite area is marked by large and small unweathered "kernels." The fact that the sedimentary strata dip towards the granite indicates that it has a laccolitic form.

The strike of the sedimentary strata near the granite is generally north-north-west. The dip is everywhere very great, and generally to the west-south-west. The character of the rock on the junction varies from fissile to massive. At from ½ to 4 chains from the granite the slates have an "augen" structure, with "eyes" consisting chiefly of chalcedony, and crystalline actinolite and epidote; for example, at the top of the incline tramway.

About 3½ chains to the east of that point is the outcrop of a bed of limestone; a quarter of a mile up Matheson's Creek is another large outcrop of granular limestone, with magnetite on the west, and there are other thinner beds, both above and below this.

The worked ground of Biggenden Mine is included in an east and west direction, between the top of the incline and the first large limestone outcrop, and between Matheson's Creek and the horse-walk prospecting tunnel, 7 chains to the south. It consists of slates, which have been variously impregnated and replaced by magnetite and calcite, and chalcedony and scorodite, and altered into actinolite rock. The limestone forms a "footwall" to the deposit, the hanging-wall being defined by one large and several small fissures, to which the deposit owes its auriferous, and possibly also its bismuthic character, for traces of bismuth can be found in the flucan.

The main magnetite deposit was opened by a quarry, known as the open cut (*see* Plate 1) for a length of over 3 chains and a width of half-a-chain. It consists of solid magnetite, with patches of calcite, and disseminated bismuth ores. At the northern end, where it approaches the surface, it carries little bismuth ore; but at the southern end large bunches, up to 6 inches in diameter, of native bismuth and bismuthinite occur. A belt of slate adjoining the magnetite on the west is about 10 feet thick, and separates the main magnetite body from a smaller one and the auriferous actinolite rock (to be described below). When exposed in the open cut the slate carries oxidised bismuth ores, chiefly bismutite.

Immediately east of the massive magnetite are lenticular masses (several feet in length) of crystalline calcite, presumably of secondary origin. Between them and the big limestone outcrop the slates are strongly ironbearing. A shaft there was sunk 42 feet, and Mr. Rands reported that it "passed through—first, a decomposed rock, with lumps of native bismuth and carbonate of bismuth; next through a siliceous rock containing a large amount of arsenical pyrites; then through 25 feet of calcite; and, lastly, through solid magnetite." This proves that there is magnetite east of the calcite in the cobalt cut (*see* Plate 2), as indicated by the character of the stone on the surface. There is also, however, a good deal of "arsenical rock"—slate partly replaced by chalcedony and scorodite.

As for extent in depth, the magnetite shows no thinning at Learoyd's (the intermediate) Level; at Roberts' and Hester's Level, 145 feet from the surface, it seems to have increased, but its relation to the slates there is not yet quite apparent. Bismuth ores, however, occur disseminated in it with gold at the last-mentioned level.

The ore deposits appear to be of two growths: the first, the impregnation and replacement of the slates with magnetite; the second, the decomposition and impregnation of the actinolite slate with gold. It is probable that the ferrous silicates of the original tuffs may have been the source of part, at least, of the iron. The intrusion of the granite into the sedimentary rock must have caused the circulation of solutions. Such solutions, if alkaline, would attack the silicates, dissolving silica and alumina but leaving iron oxides, now found alone as magnetite, and with lime, magnesia, and silica, as actinolite. The entire absence of alumina and the general absence of silica, except that in the actinolite, points to this action having taken place. Epidote and garnet are conspicuously absent from the ore deposits, but the former mineral (accounting for the leached-out alumina) occurs in the slates, both east and west of the deposit, and the latter (reddish-brown and dirty-green andradite) in the limestones exposed in Matheson's Creek.

One of the most interesting mineral occurrences in the mine is the calcite lining some of the "pipes," as at Hester's and Matheson's Openings. The crystals are all oriented so that their cleavages agree with that of the calcite to which they are attached. They thus represent its actual growth. The crystals consist of combined positive and negative rhombohedra with unequal parameters. Other pipes in calcite, as at the cobalt cut, show by their smooth surfaces the dissolving action of some solution, proved, by a coating of fibrous aragonite on the walls, to have been warm. The black gold-bearing bismuthic and cobaltiferous wad powder, mentioned in Mr. Rands' report, occur in this kind of pipe, but is no longer mined. Erythrite, the hydrous arsenate of cobalt, has been found in the past as small specimens, but only stains in the slates are now to be seen.

The deposits have been worked for gold and bismuth only, the bismuth (native, carbonate and sulphide) chiefly in the magnetite, and the gold chiefly in actinolite rock.

The bismuth in the open cut occurs in "bunches" and "shoots," mostly within a couple of feet of the hanging-wall. Thus Matheson's Winze (*see* Plate 1) was sunk on a rich shoot, which is believed to continue below the bottom of Matheson's Opening. At the bottom level, the bismuth is disseminated further through the magnetite. It is reported that in large crushings the ore seldom ran higher than 1 or 2 per cent. of bismuth.

The gold ore—locally known as hornblende rock—is an actinolite slate, of which the actinolite is often altered into calcite, viridite, and magnetite. It is richest, however, where altered into a brown micaceous material or a greasy green magnesian silicate, within a foot or two of the hanging-wall fissure. The solid undecomposed actinolite slate, at a distance from the fissure, is not auriferous.

The actinolite rock is being opened in the face of the open cut, and is thought to be about 10 feet wide there. (*See* Plate 1.) Splendid dollyings can be got from parts of this, but most of it is barren. The body rapidly contracts towards both the north and south, its total length being about 160 feet. The fault flucan yields traces of bismuth and magnetite, and though not auriferous where prospected, there may be shoots of gold elsewhere in it.

The magnetite appears to be remarkably free from impurities, but analyses of the samples collected have not yet been completed. It may be of importance in the future as a source of iron, in which case limestone in the neighbourhood would have a corresponding value as flux. Howard, the chief centre of the Burrum Coal Field, is distant from the mine 72 miles by rail.

The workings consist of:—The main open cut, the cobalt cut, the gold cut, an adit, a main shaft, and various drives and crosscuts.

The main open cut (*see* Plates 1, 2, and 3) is about 60 feet deep and covers about three-quarters of an acre, but is only from 10 to 20 feet in width at the bottom. Near the top on the east is a drive in actinolitic slate, and there are two others on the south and one on the north-west, all in magnetite and actinolite-bearing slates. A winze has been opened in the centre in bismuthic magnetite, and connected through Matheson's Opening with Learoyd's Drive, 29 feet below. A level was carried 60 feet to the south of the winze, and the ground beneath it was stoped out for several yards. A crosscut, 20 feet long, connects the southern end of this level with the auriferous actinolite rock on the west, along which is a drive. From this drive a winze was sunk to the level below. A crosscut was also put through the slates and magnetite west of the shaft, at a slightly lower level than the last, but to the same formation. The Old Gold Level was then driven to both the north and south (*see* Plate 4), and a winze was sunk near the southern end to Learoyd's Level; as the ore it passed through was poor, stoping was begun above it and carried almost to the surface on very rich ore. (*See* the 1892 output in Appendix 1.)

The latest work has consisted in extending the Old Gold Level a few feet to the north and in sinking a winze, called the New Winze, from the same level, at the end of the crosscut from Matheson's Winze.

The cobalt cut (*see* Plate 3) is only a few yards east of the main open cut, and, like it, is about 10 feet wide at the bottom, the sides sloping up so that the top is 1½ chains in length and ½ chain in width. A tunnel and crosscut have been opened at the bottom, and another tunnel near the top. The ore worked here was the cobaltiferous wad, occurring in "pipes" in the calcite.

The gold cut (*see* Plate 2) now forms the south-western part of the main open cut on the level of the brace of the main shaft.

Learoyd's Level (*see* Plate 5) opens from the hillside above Matheson's Creek and runs about 130 yards to the south, the last 210 feet being along the junction of the magnetite and slates. There are two short crosscuts on the west and one on the east (Matheson's).

The main shaft (*see* Plate 4) is just outside the south-western end of the main open cut. It is 3 feet by 6 feet, divided into two compartments and timbered almost to the bottom, 150 feet below the brace. A crosscut from the shaft at 145 feet depth runs for about 10 yards north-east to the western boundary of the magnetite, which is followed by Roberts' Drive for 90 feet to the north-east and by Hester's Drive for 130 feet to the south.

In exploitation the auriferous belt of actinolite rock has been followed on all the levels, but below the Old Gold Level the ore seems to have become rather impoverished, the gold being probably concentrated in a shoot or shoots.

The only work of any extent, done on the bismuthic magnetite, was between Matheson's Opening at Learoyd's Level, and the open cut. The whole of the deposit, from the fissure on the west to the limestone on the east, should have been prospected by crosscuts at Learoyd's and Roberts' and Hester's Levels.

It is intended to follow the rich shoot in the New Winze and to open up that below Matheson's Crosscut.

It might prove profitable to follow to the north the calcite vein on Roberts' Level. Hester's Drive follows it for a short distance to the south from the crosscut, and the daily dollyings, obtained when driving it, ran from 12 gr. to 9 dwt. of gold per ton.

At the present time the ore from the mine is hand-picked, to a limited extent, at the surface, and trucked to the mill. It is tipped onto grizzlies and hand-fed into the crushers, one Blake and two Dodges. The ore is then passed by Challenge Feeders into the Huntingdon Mills, two of which have a capacity of 4 tons per eight hours, and one of 2½ tons, the screen used having 250 meshes per square inch.

The pulp from the mills is washed over copper tables onto the Frue Vanners, six in number. The vanner concentrates, consisting of magnetite, bismuth (native and sulphide), and gold, are dried on a furnace on the floor and then carried to a bin on the floor above. From this they are delivered into a magnetic concentrator of the revolving cylinder type, which has a capacity of 7 tons of vanner concentrates per twelve hours. A current of 16 amperes at 55 volts is employed.

Much trouble has been experienced in amalgamation owing to the "sickening" of the mercury. This is due, in the first place, to the bismuth, but is accentuated by the presence of arsenic and the greasy magnesian silicate formed by the decomposition of actinolite, which is so plentiful in the ore. Under the circumstances it seems advisable to reject amalgamation entirely, and, by careful concentration, to save the gold with the bismuth. On the last day of my visit a crushing of 5 tons of mixed sulphide and oxidised ores was made, yielding 17 cwt. of vanner concentrates, from which 3 cwt. of bismuth concentrates were obtained. These bismuth concentrates assayed 9·12 per cent. bismuth, making a total of 1·5 per cent. of metallic bismuth in the ore.

Bismuth occurs in the ore pipe at Mount Shamrock, 7¾ miles distant from the Biggenden Mine, in a direction 30 degrees west of north. Mispickel is there the chief metallic mineral, and blende is present in small amounts. The mine was worked for gold, but a few tons of bismuth were exported in 1887.

The Saxon and Bohemian Erzgebirge is the oldest and is still the chief bismuth-producer, but Peru and Bolivia are stated to contain large supplies. The Western United States have of late years been exporting in increasing quantities. Besides Queensland, New South Wales is the only other country in which the metal is mined.

In Saxony and Bohemia bismuth occurs with cobalt, tin, and silver; in Bolivia with tin; and in the United States with silver and lead (galena), and with iron (pyrites). In New South Wales, at Kingsgate, near Glen Innes, it occurs with molybdenite, gold, mispickel, and tin. The general presence of silver is thus noticeable, while in three widely-separated countries tin is an associate.

The Biggenden deposit does not resemble any of those above mentioned. It has, however, a close resemblance, as an iron ore deposit, to those of Santiago, Cuba,* where the ores are associated with hornblende and epidote schists and crystalline limestone, all penetrated by dykes of porphyry. The origin of the ore is thought by the author to be connected with the chemical changes to which the metamorphic rocks were subjected at the time of their metamorphism.

* "Iron ores of Santiago, Cuba," by Arthur C. Spence, in the *Engineering and Mining Journal*, 16th November, 1901.

In the neighbourhood of Mount Biggenden are a number of other workings, all of which have been abandoned for some years.

Mount Hastings.—At Mount Hastings is an occurrence almost identical with that at Mount Biggenden. The hill itself is formed of massive slates, with an "augen" structure in places. Mount Hastings Creek follows the boundary between the slates and granite on the west, but on the north it has made a sweep into the granite. The north-western slope of the hill has been well prospected. The ore deposits consist of slates impregnated, and in places replaced by magnetite. A quarry, 30 feet in length and 15 feet wide, has been opened in these slates, and several fissures have been followed for a few yards into the hill. In these fissures the auriferous oxidised bismuth ores were found, but in too small quantity to be payably worked. A main shaft was sunk about a chain to the north of this quarry, near the point where the granite bends to the east across the bedding. (*See* Map 1.) The shaft is now filled in, but it can be seen to be in solid magnetite, about 3 feet across, wedged in between a bed of granular marble on the east and a couple of feet of fissile slate on the west, which separates it from the granite. The marble is visible for only a chain to the south, from where it is cut off by the granite. A couple of chains east of this shaft is an opening on a fissure, between actinolite slate on the west and limestone on the east. The calcite of the limestone appears to have replaced slate and the cementing material of a conglomerate. There is a little magnetite here with actinolite and traces of copper.

Silver Mine.—This lies about midway between the Biggenden and Mount Hastings Mines, and consists of a small quarry in the usual north and south striking epidote-actinolite slate, with narrow bands of magnetite. Granite occurs about a chain to the west and limestone a short distance to the east. The work done was in prospecting for gold.

Iron ore (magnetite) has been worked on the southern boundary of the Biggenden Lease.

Don Jon Workings.—These are about a mile north of the Biggenden Mine, on gullies opening into Two-mile Oaky Creek, at the school-house. Trenches, small shafts, and quarries are scattered over an area about a quarter-of-a-mile square. The country is slate and limestone, granite passing a couple of hundred yards to the west. The first trench and shaft are about a chain from the granite, in slate and limestone. The ore consists of mispickel with small grains of bismuthinite. East of this shaft numerous small quarries were opened a few years ago to supply Aldershot with iron ore, which is reported to have carried 70 per cent. iron and to have sold for 15s. per ton, delivered at Degilbo Railway Station. The quarries lie on an east-north-east line, and they are probably on a series of small lenticular deposits. In most of the quarries the ironstone cut out within 15 feet of the surface. The iron ore towards the granite becomes somewhat siliceous. The slates at the Don Jon are often actinolite bearing and are sometimes completely converted into actinolite, as at the Biggenden Mine; they then carry magnetite and a trace of bismuth, but no gold.

Mount Havilah.—Iron ore has been worked on the south side of Mount Havilah, a quarter-of-a-mile north of the Don Jon workings, but this place unfortunately was not visited.

A copper deposit in slate on the northern slope of Mount Havilah has been exploited by a shaft and adit. It gave great promise when worked about fifteen years ago, but has now been long abandoned.

It is noticeable that there are slight indications of copper in similar positions with regard to the granite—*i.e.*, about a quarter-of-a-mile from it, at a number of places between Mounts Hastings and Havilah.

APPENDIX 1.

The discovery of the Biggenden ore deposit was made in 1888, but the first recorded output was in 1890. From 1895 till last year the mine has been under exemption, either because of the general scarcity of water or the absence of a market for bismuth. The returns below were furnished by the acting warden. The price of bismuth has been standing rather constantly during the past year at 6s. per lb.; this was the inducement to the company to recommence active operations last year. The prices for ore quoted in the last *Mineral Industry*, when the metal is at the above price, are :—

	£	s.	d.	
10 per cent. ore	31	5	0	per ton.
15 „ „ „	52	0	0	„ „
20 „ „ „	73	0	0	„ „
30 „ „ „	114	10	0	„ „
40 „ „ „	156	5	0	„ „
50 „ „ „	208	6	8	„ „

Date.	Ore Crushed.	Bismuth Concentrates.	Percentage of Concentrates.	Value of Concentrates.	Weight of Gold Obtained.	Value of Gold per Oz.
	Tons.	Tons cwt.	Per cent.	£	Oz. dwt.	£ s. d.
March, 1890	...	3 0	...	210	66 10	...
June, „	...	26 10	...	1,060	106 0	...
December, „	199	...	...	...	197 10	...
„ 1891	3,707	78 5	...	8,015	2,173 13	...
„ 1892	4,336	90 0	24	9,990	2,004 0	3 13 0
March, 1893	554	15 0	...	1,710	370 10	...
June, „	1,247	40 0	25	...	277 0	...
September, „	266	11 0	...	...	82 0	...
„ 1894	Tailings	...	...	...	394 4	...
March, 1895	1,586	22 3	...	1,395	53 0	3 7 0
June, „	1,158	19 1	...	1,200	27 10	...
„ 1900	180	2 10	...	...	...	...
December, 1901	5	0 3	...	...	...	...
	13,238	307 12	...	...	5,751 17	...

APPENDIX 2.

Assays by the Government Analyst.

Sample from top of New Winze, consisting chiefly of magnetite, with a little actinolite and calcite, shot with bismuth.

Assay: Gold and silver, traces; bismuth, 4 per cent.

Sample from Learoyd's Drive and Matheson's Opening, consisting chiefly of magnetite with a little calcite and actinolite and traces of mispickel, bismuth, and copper pyrites (?)

Assay: Gold, 10 gr. per ton; silver, 19 gr. per ton; bismuth, traces.

Sample of the actinolite on the inner portion of Learoyd's Drive, consisting chiefly of magnetite, actinolite altering into calcite, and a little bismuth.

Assay: Gold, silver, and bismuth traces.

Sample from crosscut from New Winze to Learoyd's Drive, consisting of undecomposed actinolite rock, slate, actinolite rock impregnated with calcite and bismuth, and calcite replaced by actinolite, bismuth, and quartz.

Assay: Gold, 1 dwt. 18 gr. per ton; silver, 1 dwt. 18 gr. per ton; bismuth, trace.

Sample from chamber at beginning of Hester's Drive, consisting of magnetite and actinolite, replaced by a little calcite and bismuth.

Assay: Gold, 10 dwt. 14 gr. per ton; silver, 3 dwt. per ton; bismuth, 2·9 per cent.

Sample from chamber at end of Hester's Drive, consisting chiefly of magnetite, with calcite, a little actinolite, and bismuth, replacing the calcite and actinolite.

Assay: Gold and silver, traces; bismuth, 0·73 per cent.

Sample of vanner concentrates, consisting chiefly of magnetite, taken by the manager.

Assay: Gold, 18 dwt. 15 gr. per ton; silver, 5 dwt. per ton; bismuth, 9·12 per cent.

PARADISE GOLD FIELD.

Paradise Gold Field was proclaimed in November, 1890. It has an area of 13 square miles, being roughly oblong in shape, with a length of 4 miles along the Burnett River, and a breadth of 3 miles along the Bin Bin Range. Paradise Creek flows from the south across the field into the Burnett River, and Finney's Creek enters the river a mile above it. The whole of the worked ground is included between the two creeks.

Payable gold was discovered in 1889, with the result that a town quickly sprang into existence. It flourished for five years, when gradual desertion of the field began. There are now only about a score of men and half-a-dozen families in Paradise.

Some fifteen lines of reefs have been profitably worked. They are, as rule, thin, much faulted, and seldom yielded more than an ounce of gold per ton crushed. As the mines were worked chiefly without the aid of outside capital, the gold won has been only sufficient to pay for immediate development, and thus the deep ground has not been tested.

Mr. Rands visited the field two years after its discovery, and made a detailed report on it.*

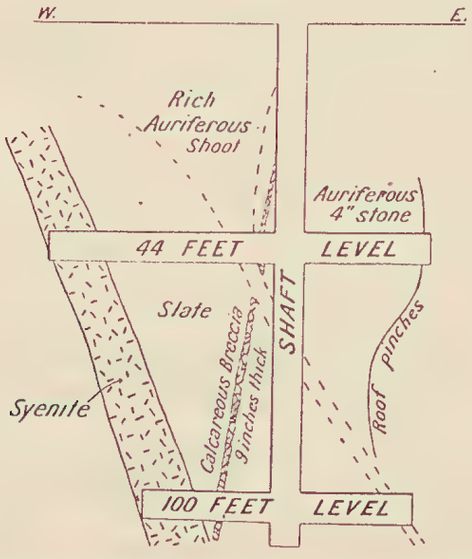
At the present time no mines are being worked on the Paradise Field. The Berrie-Paterson P.C. and the Great Eastern were the last to close down—a few days before my visit—but it is only a few months since the Lady Margaret was abandoned. All the mines on the field were visited, but, with the exception of the Berrie-Paterson and the Great Eastern, the workings were either quite inaccessible or only partly open. Though the shafts can only be descended for short distances, the little to be seen was, as a rule, very favourable. Much work has been done on the Saint Mungo and Lady Margaret lines.

The reasons given for the abandonment of the mines are various:—The Great Eastern because of impoverishment of the reef and influx of water with depth; the Lady Margaret because of careless exploitation and consequent flooding; the Philadelphia because of the collapse of the surface stopes; the Nancy because too thin; the Paradise P.C. because of impoverishment with depth (there are said to be 5 or 6 feet of 12 dwt. quartz in the lowest workings); and the Eureka, Golden Spur, Berrie-Paterson, and Saint Mungo because of faulting.

Lady Margaret.—A 4-inch reef underlying 60 degrees to the south-west, and a 9-inch reef underlying 45 degrees to the west-south-west, were called the foot and hanging-wall reefs. The reefs have been stoped out to the surface from a depth of 80 feet. The Plunger Shaft was sunk, after the flooding of the stopes, to a depth of 200 feet, about 100 feet south of the underlie shaft; but the reefs sought were not found, probably because the shaft is on a "horst" between two faults. A leader dipping 1 in 4 to the south-south-west was cut near the top of the Plunger Shaft.

Great Eastern.—A quartz vein, 4 to 7 inches thick, strikes east-north-east and dips 6 in 1 to the north for 30 feet, when it becomes vertical for a few feet, then underlies slightly to the south for 25 feet, and then dips to the north again. The vertical portion was richest. The shaft is 105 feet deep, but is flooded below 44 feet in depth. The country rock is slate.

Fig. 1.



Longitudinal Section of the Great Eastern.—Scale, 20 feet to an inch.

The details on the figure, below 44 feet in depth, were supplied by Mr. Bell, the last manager.

The last work done was to drive through the trachyte dyke on the top level, but the slate beyond has not yet been broken into, and it is not known whether the reef has been thrown or not. To the east of the shaft the reef cut out in steps.

*Report on the Paradise Gold Field.—By William H. Rands, Assistant Government Geologist. Brisbane: By Authority, 1891.

Berrie-Paterson P.C.—The average thickness of this reef was 4 inches, and it is said to have carried 3 or 4 oz. of gold per ton near the surface. It has been exploited in a rather unusual manner, the shaft having, almost from the beginning, followed instead of preceding the workings. There is now a level 60 feet below the bottom of the shaft, which is 170 feet deep. An adit was driven along the reef from the hillside 30 feet below and 100 feet distant from the brace of the shaft, and carried on for 25 feet to a fault. The 100-feet level runs 30 feet to the same fault on the west and 100 feet to the east, where there is a short crosscut to a "stringer" south of the reef. A winze connects the 100 and 170 feet levels, besides the main shaft and a crosscut. The 170-feet level has a length of 185 feet, and the bottom level a length of 80 feet.

The fault on the west has clearly thrown the reef to the south, but no exploratory work has been done to find it. The reef seems to have thinned out into leaders at a depth on the east where it was last worked. The walls are good, and the reefs may increase in thickness at a greater depth.

Allen's Reef.—At a point about 150 yards north of the Paradise P.C. Allen's Reef strikes east-south-east, but on the west it bears gradually round to the north. While in porphyry the reef was rich in gold, but, like the P.C. Reef, it becomes barren in the slates. Very little can be seen at the workings now.

Philadelphia.—There is said to be in the bottom of the shaft 3 feet of quartz, carrying 9 dwt. of free gold, with 9 dwt. in the concentrates, a total of 18 dwt. per ton.

The Crown is the only battery now standing. It consists of two sets of four stampers. The crushing returns are given in Appendix 1.

Of late years the battery tailings have been tested and found to be rather rich in the precious metals. The first attempt to cyanide these tailings was made in 1896. Little success was attained, but at the present time renewed efforts are being made in their treatment.

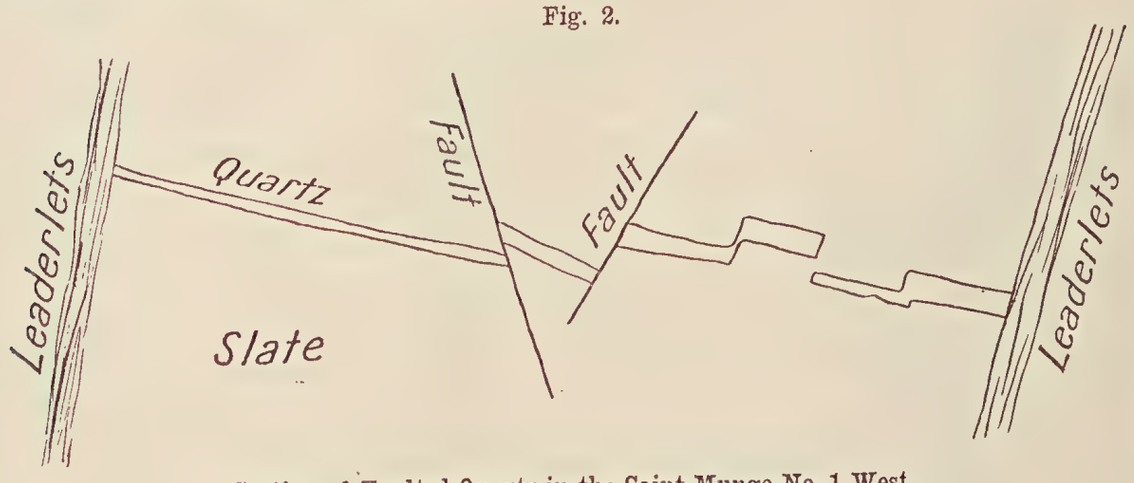
At the Crown Battery the tailings have been estimated to carry 6 or 7 dwt. of gold per ton, and there are about 1,000 tons yet to be treated. The percolation vats there are three in number; they are built of wood, and have a capacity of 10 tons each.

Learoyd's Cyanide Plant is on the Burnett River at the base of the tailings from the Saint Mungo Battery. The percolation vats are four in number, and made of timber; they are 4 feet in diameter and 5 feet deep.

Wells's Cyanide Plant is a couple of hundred yards above Learoyd's. The two percolation vats are constructed of concrete, and are each 7 feet square and 3 feet deep. Capacity, 8 tons.

The Paradise Reefs are true fissure veins, the main ore-bearing fissures having, as a rule, an east and west trend. There seems to have been produced, with and at right angles to them, a series of smaller fissures, which have often caused faulting. Good examples are to be seen in the Great Eastern and in the Saint Mungo No. 1 West.

Fig. 2.

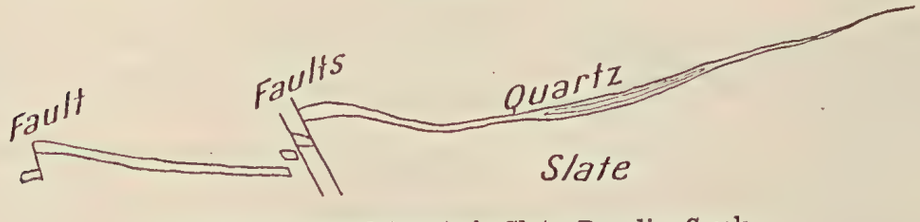


Section of Faulted Quartz in the Saint Mungo No. 1 West.

Scale $\frac{1}{10}$.

In Paradise Creek, just above the river, the section shown in Fig. 3 may be seen.

Fig. 3.



Section of Faulted Quartz in Slate, Paradise Creek.

Scale $\frac{1}{10}$.

It is evident that the smaller fissures, dislocating the main ones, must have been formed before the quartz of the veins was deposited. It should thus have been easy to find the faulted portions of the reefs, as there appears to have been generally a connecting string of quartz following the fault plane.

Faulting has always been considered the chief trouble, and it has been hoped that on sinking the country would become more settled. Such is very unlikely; in fact, it would seem that the cross-courses become stronger at a depth. It should also be remembered that the cross-courses have probably been connected with the enrichment of the veins, and are sometimes themselves the ore-bearing fissures.

The country rock at the Paradise P.C. is porphyry; elsewhere it is slate and schist, easily worked.

Limestone occurs in the ridges east of Paradise Creek in thin contorted beds, with a crystalline granular or fine-grained fissile structure. No fossils could be found in them. The limestone is fairly pure, and is burnt in holes dug in the bank of the creek for use in the cyanide plants.

A basalt flow follows the course of the Burnett River, from 4 miles below to 4 miles, or possibly more, above Paradise. It must fill the old river channel, for "wash" can now be seen under it in Finney's and Paradise Creeks (*see* Plate 11B), the river having formed a new channel in the easily eroded alluvial beside it. The river has also cut into the slates below the alluvial, from 6 to 10 feet, since the eruption took place. (*See* Plates 11A and 11B.) At the mouth of Bin Bin Creek the river has cut through the basalt. The thickness of the flow is from 30 to 60 feet. Its width is nowhere greater than a couple of chains, and generally not more than half-a-chain is uncovered by talus and drift. Short side flows seem to have invaded Paradise and Finney's Creeks.

The basalt is coarsely crystalline and rough to the touch, and, though the river has had time to eat through it and to carve out terraces (*see* Plate 11A), scarcely any decomposition has yet taken place, so that the soil on it, chiefly drift, is exceedingly poor. For a depth of 6 feet from the surface the rock is strongly vesicular, the vesicles nearest the surface being largest—often 2 inches in length. (*See* Plate 12A.) Below the vesicular portion the basalt is dense, but exhibits a conchoidal shrinkage, cracking towards the base. (*See* Plate 12B.) At the bottom of the flow vesicles are often developed, evidently where the lava filled a waterhole, and at such places there are often small caverns in the basalt.

Under the microscope the basalt is found to consist chiefly of fairly coarse plagioclase laths, slightly oriented, so that the rock has a rough fluxion structure. Minute augite grains and magnetite crystals are nearly equally abundant. Porphyritic olivine grains occur, but are not plentiful. Glass was not found in the section examined.

My acknowledgments are due to Messrs. Allen, Wells, and Bell, of Paradise; to the directors, secretary, and manager of the Biggenden Mine, and to Mr. Nicholas of Mount Biggenden.

APPENDIX I.

Annual Returns.

Year.	Tons crushed, etc.	Total yield.	Yield per ton.	Value per oz.
	Tons.	Oz.	Oz. dwt. gr.	£ s. d.
1890	554	1,104	1 20 0	3 15 0
1892	1,450	2,260	1 11 2	...
1893	892	1,144	1 5 15	...
1894	2,394	2,248	0 18 18	...
1895	858	757	0 17 16	...
1896	898	972	1 1 15½	3 7 6
1897	735	997	1 7 3	...
...	44⅛ (tailings)	20½	0 9 7	3 7 6
...	9½ (concentrates)	84½	9 19 0	...
...	215 (tailings, cyanide)	71½	0 6 16	2 0 0
1898	517	680	1 6 7	...
1899	379	370	0 19 12	...
...	? (tailings)	41	...	...
...	? (concentrates)	8	...	...
1900	123	198	1 12 9	3 10 0
...	58 (tailings)	6½	0 2 6	...
...	1¾ (concentrates)	13½	7 14 21	...
1901 (incomplete)	845	174	0 4 3	...
	1,289 (tailings and concentrates) ...	362	0 5 15	...
	9,635 tons crushed	11,511½	1oz. 4dwt.	...

EXPLANATION OF PLATES.

Plate 10.—View of southern portion of main open cut, Biggenden Mine. Showing Matheson's Winze and the level on the bismuthic magnetite. The trolley line is seen to make a bend round on to the auriferous actinolite-rock face. The projection between the tunnel and the lines is slate carrying bismuth carbonates, &c.

Plate 11A.—View of basalt on which Paradise stands. Seen to be slightly columnar near the surface and massive below. Slates about 10 feet above the water of the Burnett River.

Plate 11B.—Pocket of alluvial in slates, covered by basalt. Exposed by Paradise Creek, just above the Burnett River. The alluvial pocket is about 5 feet deep.

Plate 12A.—Vesicular (columnar) surface portion of Paradise basalt, about a mile above Paradise township, on the left bank of the Burnett River.

Plate 12B.—Massive basal portion of Paradise basalt, showing shrinkage, cracking, and cavernous spaces immediately above the slates (on which the hammer rests). Finney's Creek just above the Burnett River.

[No. 173 of the Geological Survey Publications.]

Price 2*s.*]

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MAP No 1

BIGGENDEN DISTRICT

To accompany Report

BY

LIONEL C. BALL B.E.

Assistant Govt Geologist

1901

Scale 40 Chains to an Inch

40 30 20 10 0 40 80 120

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~ Alluvium | An. Andesite | Li. Limestone | F Slates | G Granite

GEOLOGICAL SURVEY OF QUEENSLAND

WILLIAM H. RANDS GOVT GEOLOGIST

MAP No 2

BIGGENDEN GOLD & BISMUTH MINE LEASES

Scale 4 Chains to an Inch

To accompany Report

by

Lionel C. Ball B.E.

Assistant Government Geologist

1901

To Biggenden

Thin bedded Slates

DAM

MACHINE AREA

Siliceous Slates

Gneissic Granite

M. L. No 7

F

Red soil

Red soil from Limestone

Slightly Magnetite bearing

Li

Limestone

Wollastonite

G

Biggenden

Matheson's

Limestone here seems to pass into Slate

Garnets abundant

Formation for Tramroad

Proposed Ore Bin Smithy

Learoyd's Tunnel

Augen Slates (Actinolite Epidote)

Cobalt cutting

Massive Slates

Mills

Double Tramroad

Ore Bin Overhead Tramline

Open Cutting

Tunnel

Old Shaft

Old workings

Tunnel

Biotite Granite

Augen Slates

DAM

Main Shaft

Windlass

Slates

Engine

Horse walk

Prospecting Tunnel

Scorodite Slates

Epidote Actinolite Magnetite

Augen Slates

G. M. L.

Creek

Biotite Granite

DAM

G

F

Garnets abundant

Limestone Gully

Li

M. L. No 2

Cu. stains in Fe.

Fe Limestones

Magnetite on the Limestone

Slates with secondary Felspar Crystals &c.

Limestone blocks

Augen Slates

G Granite

F Slates

Li Limestone

Limestone blocks

Quarry on Magnetite & Slate

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BIGGENDEN GOLD & BISMUTH MINE

Plan at the brace of the Main Shaft

Scale 53 feet to an Inch

BASED ON THE MINE SURVEY

To accompany Report

BY

LIONEL C. BALL B.E.

Assistant Govt Geologist

1901

Reference to Colours

- Slates (various)
- Limestone & Calcite
- Actinolite Slate & Actinolite (Auriferous)
- Magnetite
- Biotite Granite

BIGGENDEN GOLD & BISMUTH MINE

Plan at level of floor of open-cut

31 feet below brace

Scale 53 feet to an Inch

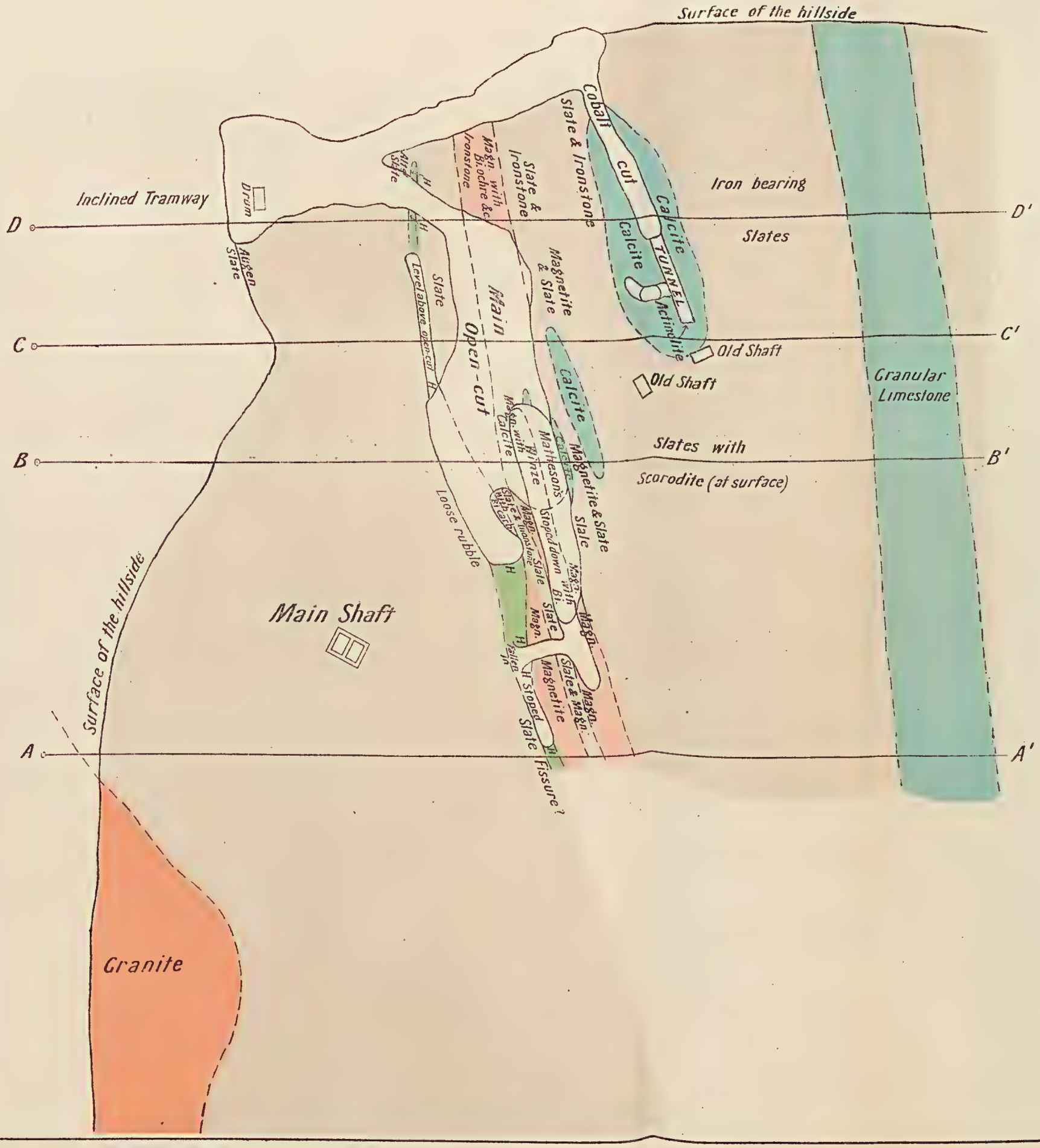
To accompany Report

BY

LIONEL C. BALL B.E.

Assistant Gov.t Geologist

1901



BIGGENDEN GOLD & BISMUTH MINE

Plan at the old Gold level

(49 ft below brace of shaft)

Scale 53 feet to an Inch

To accompany Report

BY

LIONEL C. BALL B.E.

Assistant Govt Geologist

1901

Smithy
Slates
Slates
Leaders
Adit
Gossan
Hornblendic
Fissure
Slates
Slate
Magn.
Slate
Little Bi. & Calc.
Patch of Magn. Slate
Fault fluan
Slate wall
Leaders
Slate
Drive
Fissure
Main Shaft
Slate
Magnetite
Slate
Granite
Surface of the hillside
Unexplored
Slates & Magnetite
Granular Limestone
Matheson's Opening
Bi-shoot
Magn. with a little Bi.
Magn. with Bismuthite
Bismuthite
Magn.
Vug
Vug
Magn.
Magn.
Magn.

BIGGENDEN GOLD & BISMUTH MINE

Plan at Learoyd's level (78 ft below brace)

Scale 53 feet to an Inch

To accompany Report

BY

LIONEL C. BALL B.E.

Assistant Govt Geologist

1901

BIGGENDEN GOLD & BISMUTH MINE

Plan at Roberts & Hesters level

(145 feet below brace)

Scale 53 feet to an Inch

To accompany Report

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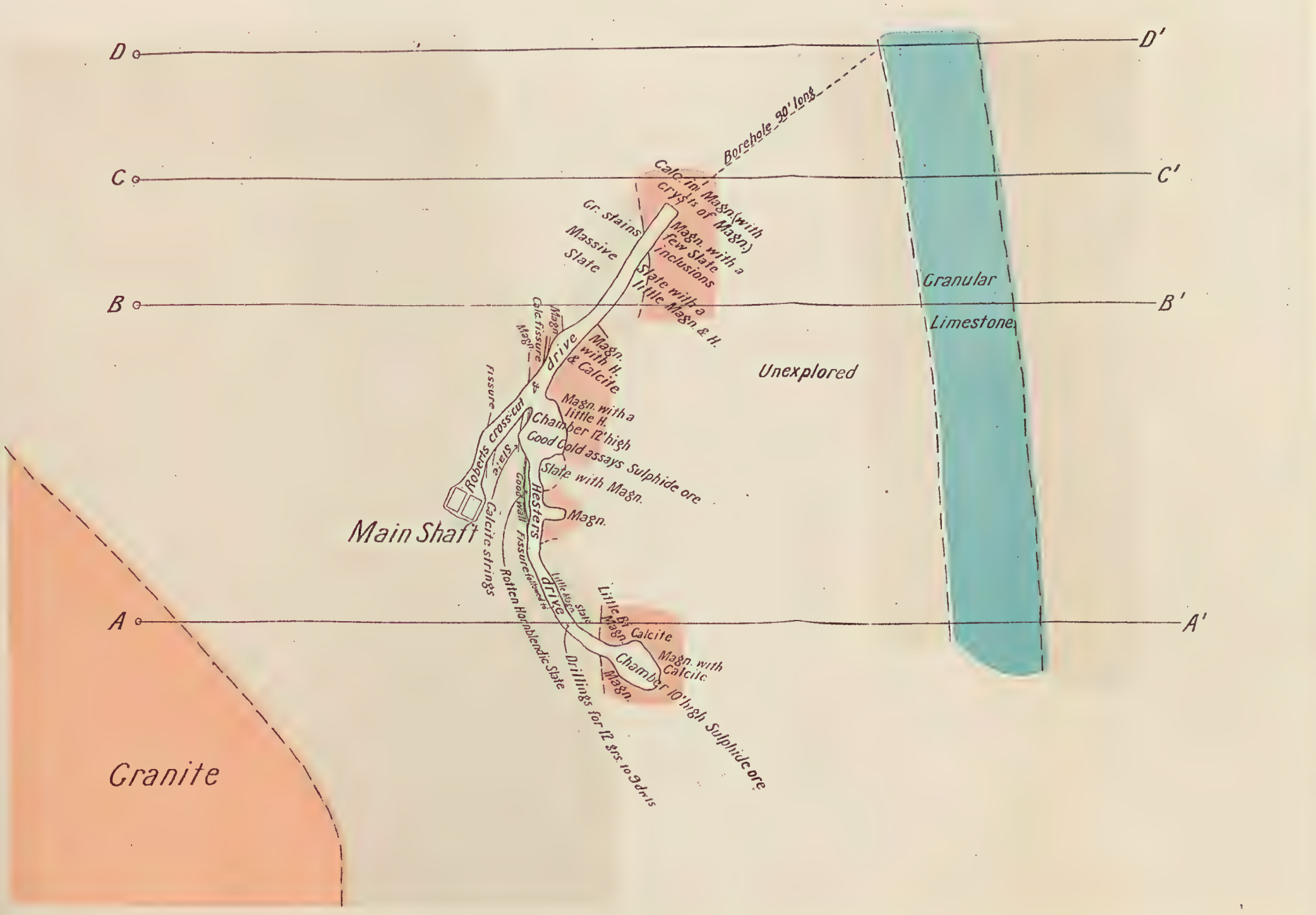


BIGGENDEN GOLD & BISMUTH MINE

Section on line AA'

Scale 53 feet to an Inch

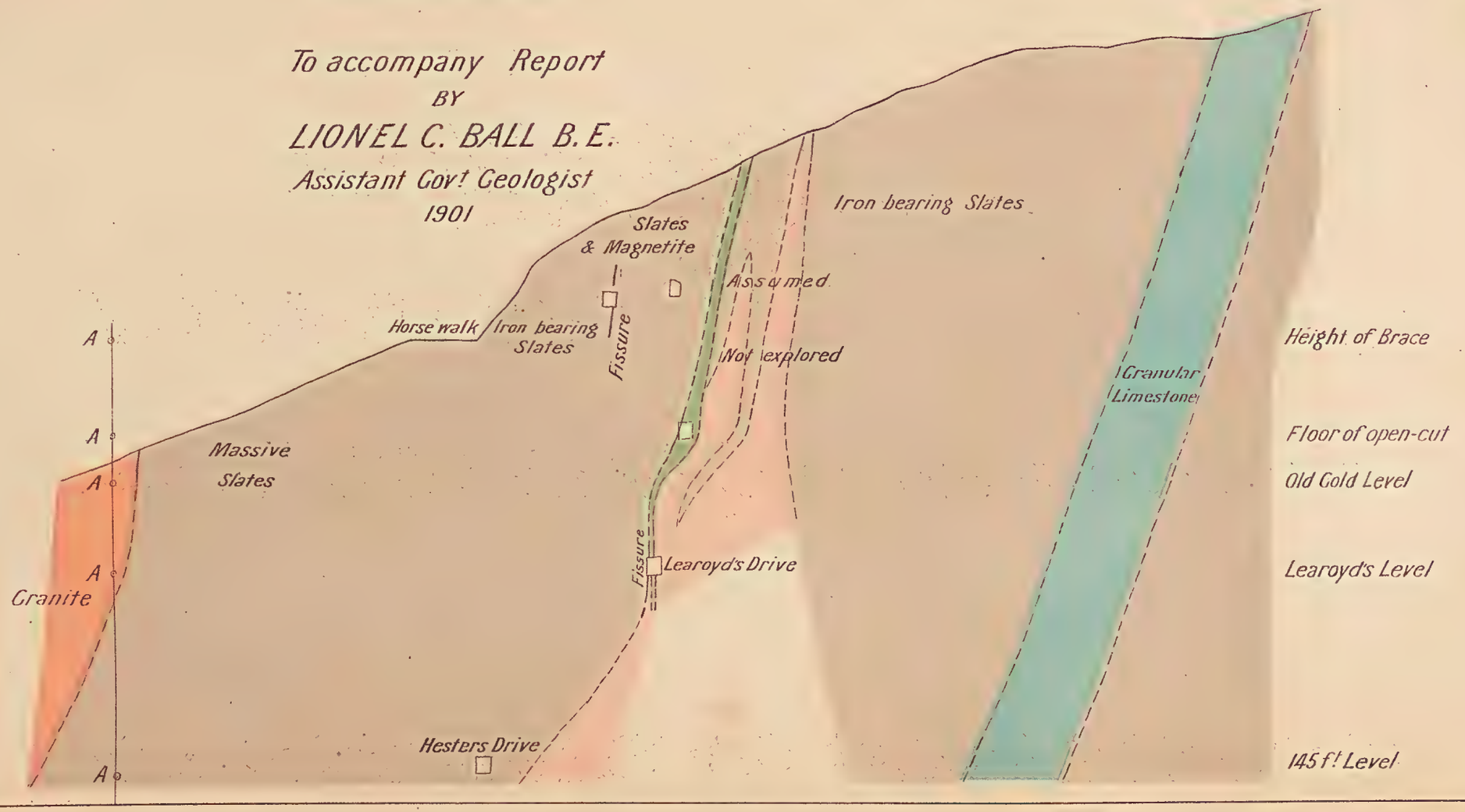
To accompany Report

BY

LIONEL C. BALL B.E.

Assistant Gov't Geologist

1901



GEOLOGICAL SURVEY OF QUEENSLAND PLATE VI

NATIONAL MUSEUM
VICTORIA

BIGGENDEN GOLD & BISMUTH MINE

Section on line BB'

Scale 53 feet to an Inch

To accompany Report

BY

LIONEL C. BALL B.E.

Assistant Govt Geologist

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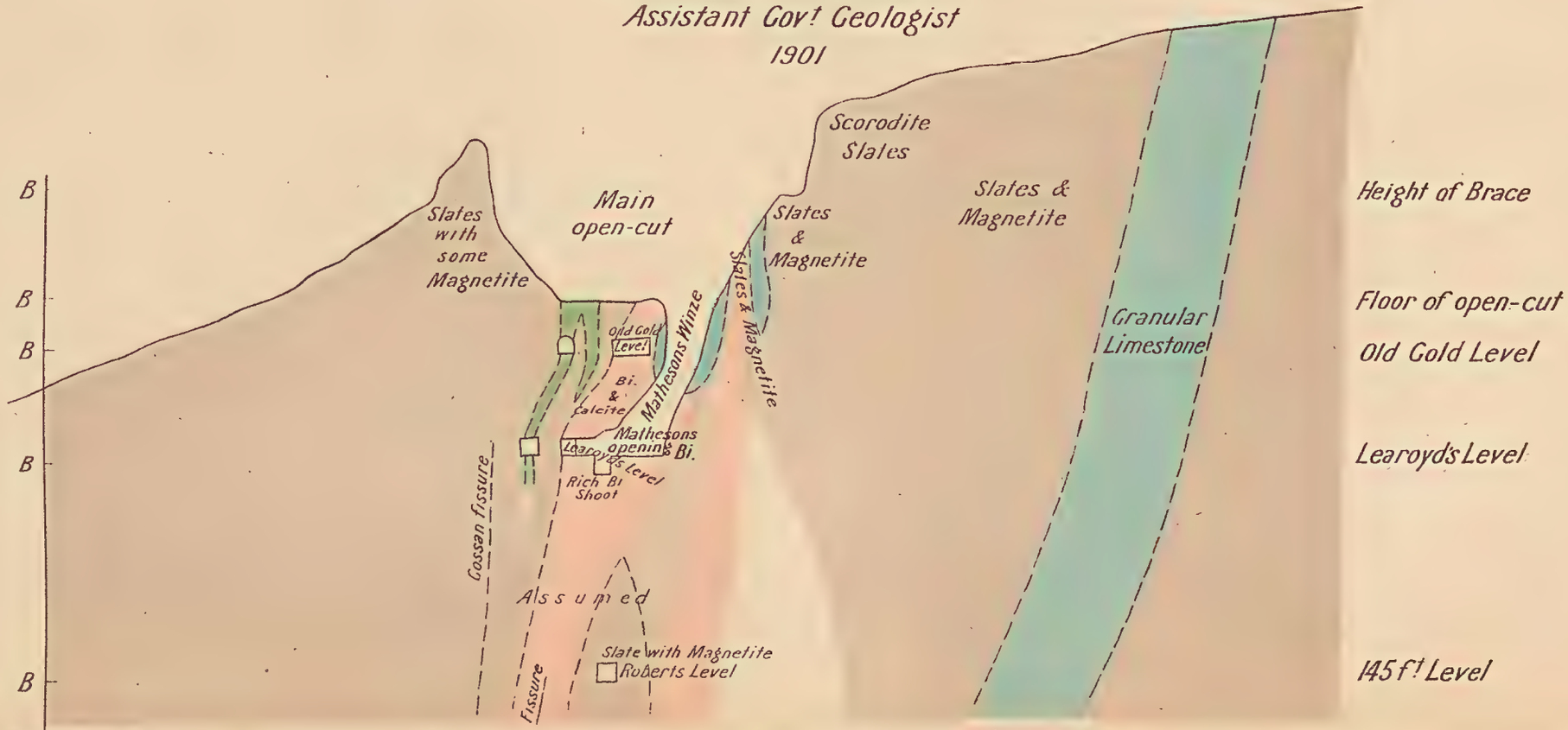


GEOLOGICAL SURVEY OF QUEENSLAND PLATE VII

VICTORIA

BIGGENDEN GOLD & BISMUTH MINE

Section on line C C'

Scale 53 feet to an Inch

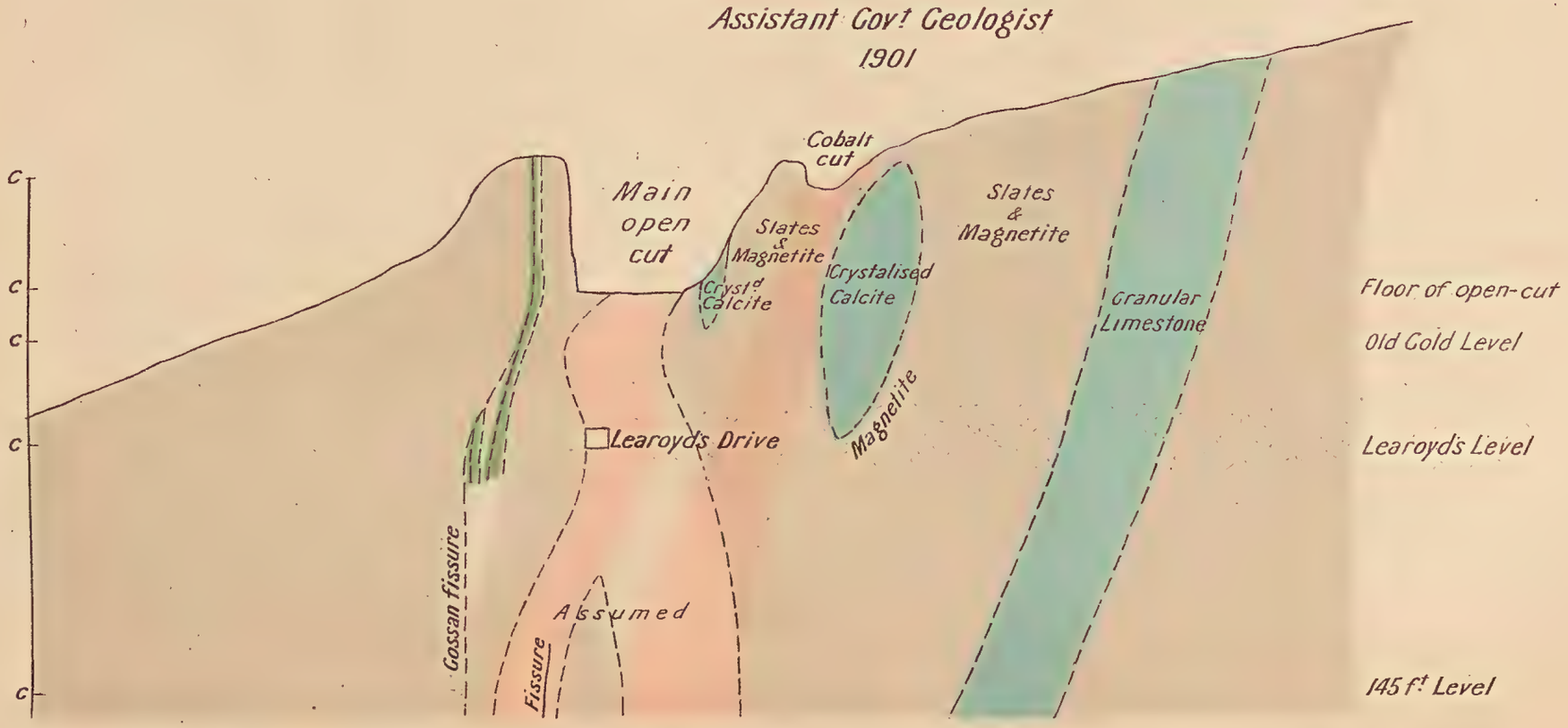
To accompany Report

BY

LIONEL C. BALL B.E.

Assistant Govt Geologist

1901



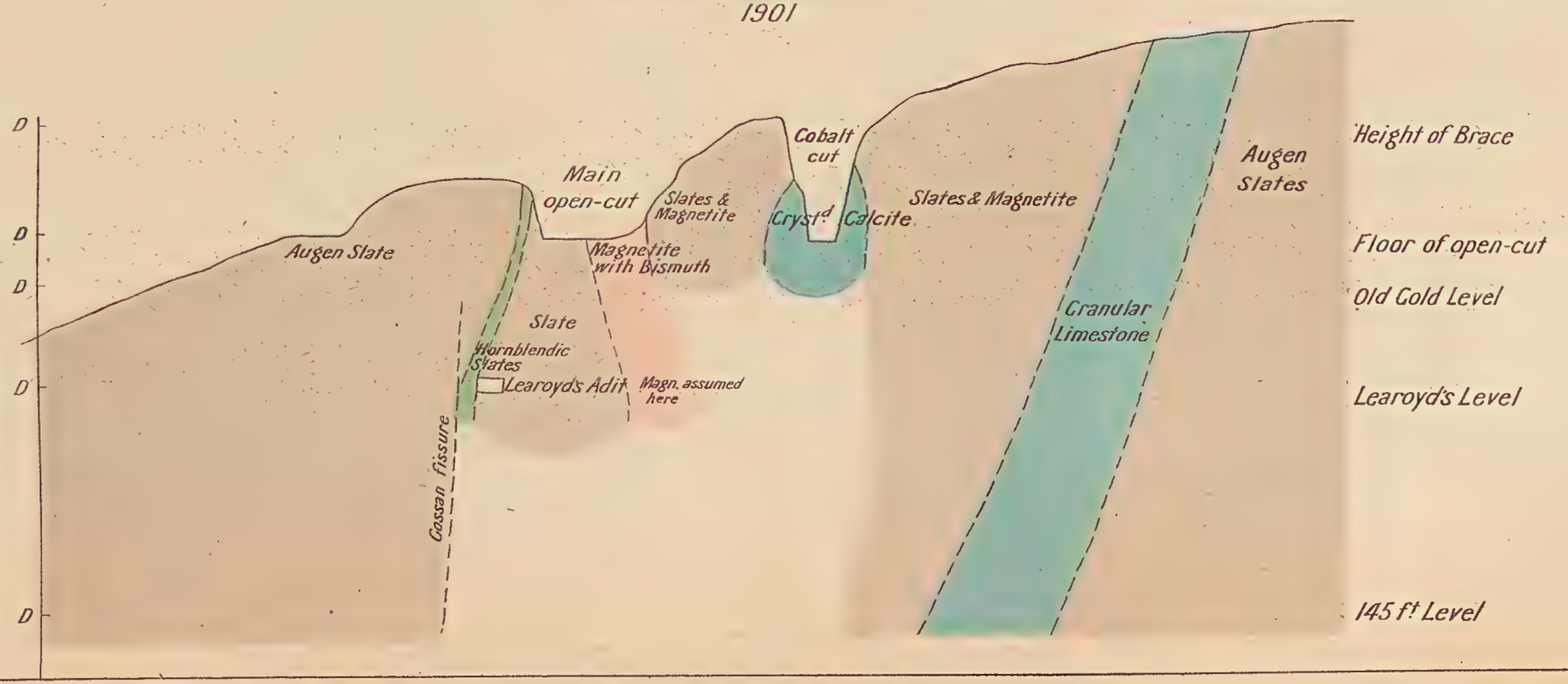
GEOLOGICAL SURVEY OF QUEENSLAND PLATE VIII

BIGGENDEN GOLD & BISMUTH MINE

Section on line DD'

Scale 53 feet to an Inch

To accompany Report
BY
LIONEL C. BALL B.E.
Assistant Govt Geologist
1901



GEOLOGICAL SURVEY OF QUEENSLAND PLATE IX

Plate 10.—View of Southern Portion of Main Open Cut, Biggenden Mine.

Plate 11a.—View of Basalt on which Paradise Stands.

Plate 11b.—Pocket of Alluvial in Slates, Covered by Basalt.

NATIONAL MUSEUM VICTORIA

Plate 12a.—Vesicular (Columnar) Surface Portion of Paradise Basalt.

Plate 12b.—Massive Basal Portion of Paradise Basalt, showing Shrinkage, Cracking, and Cavernous Spaces immediately above the Slates.

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1902.

QUEENSLAND.

THE COAL BEDS ON WATERPARK CREEK, NEAR PORT CLINTON.

(REPORT ON, BY WALTER E. CAMERON, B.A., ASSISTANT GOVERNMENT GEOLOGIST.)

[*With 2 Maps.*]

Presented to both Houses of Parliament by Command.

THE HONOURABLE THE MINISTER FOR MINES, BRISBANE.

Geological Survey Office,
Brisbane, 20th March, 1902.

Sir,—I have the honour to forward Mr. Walter E. Cameron's Report on the Coal Beds on Waterpark Creek, near Port Clinton, with two maps.

I have, &c.,
WILLIAM H. RANDS,
Government Geologist.

GEOGRAPHY AND GEOLOGY OF THE COAL ROCKS.

These coal-beds occupy an area of between 20 and 30 square miles on Waterpark Creek, which flows into the coast some 40 miles north of the mouth of the Fitzroy River. The centre of the area is about 8 miles back from the coast, and some 10 miles from the southern end of Port Clinton. It is about 27 miles from Tanby Station, the nearest point on the Rockhampton to Emu Park Railway line, which again is about 24 miles from Rockhampton.

The coal-beds lie in a roughly circular basin, enclosed by older metamorphic rocks on the north and south, and by the granite of the Mount Parnassus Range on the west. They extend out in a tongue toward the east, their eastern limit being obscured by sand dunes blown up from the shore, to a distance of some 4 miles from it. Waterpark Creek flows along the junction of the granite and the coal-beds, forming the western boundary of the latter, and, breaking through the metamorphic rocks along their southern boundary, enters the sea some 10 miles further down. The area covered by the coal-beds consists of flat wallum and ti-tree country, affording few exposures, and giving little information as to the character and disposition of the underlying rocks. Map No. 1, on a scale of 4 miles to an inch, shows the position of the coal area relative to the coast and surrounding country. Map No. 2 gives the more detailed topography of the immediate neighbourhood, as accurately as it could be determined from existing maps, supplemented by some rough chain and compass surveying by Mr. C. C. Bertram, of Yeppoon, and some prismatic compass triangulation by myself.

The evidence for the occurrence of coal in these beds was first found in outcrops exposed along the banks of Valentine Creek above its junction with Waterpark Creek, and also along the latter creek below the junction. Valentine Creek and Waterpark Creek are perennially running streams, with heavy sandy banks. The outcrops of the coal and its associated beds are found only at scattered points, where this sand has been washed away, or below the surface of the water in the bed of the creek. About a quarter of a mile up Valentine Creek from its junction with Waterpark Creek a pit has been sunk on the right bank of the creek to a depth of 14 feet on a seam of coal seen outcropping in the bed of the creek. This pit shows the coal to be standing at a very high angle with a strike in a direction north 10 degrees west and a dip to east 10 degrees north of about 70 degrees. The shaft is in coal all the way, the coal being divided into two sections by a thin seam of fireclay, first met with some 3 feet down the shaft, and striking diagonally across it to the bottom. The seam of fireclay is from 2 inches to 3 inches in thickness. There is thus exposed above the fireclay a thickness of about 3 feet of coal, and below it a thickness of about 2 feet. The whole thickness of the seam, however, is not exposed in the shaft. For

about 15 feet up the stream from the shaft and also for about 35 feet down the stream coal can be picked out of the solid bed of the creek under the sandy bank. This outcrop could not be satisfactorily examined, being under water, but it appeared to be clean coal. Allowing for the fact that the stream cuts diagonally across the strike of coal, and for the dip of the seam, I should judge that there is here a thickness of coal of at least 30 feet. For the next 35 feet below this coal the bed of the creek consists mostly of shale, when another bed of coal is again met with and continues for about 48 feet, representing a second thickness of coal of perhaps another 30 feet.

On continuing down Valentine Creek to the junction, sandstones and shales are met with, and the next outcrop of coal is found in Waterpark Creek, about half-a-mile below the junction. The outcrop is almost covered by water, but it can be recognised as standing almost vertically, and as striking a little west of north. This strike and dip point to the conclusion that this seam is a continuation of one of the large outcrops seen in Valentine Creek, though it is impossible to say which. The outcrop is drawn on the map in continuation of that on which the shaft was sunk, as this seems to be the more likely disposition of the coal.

It is thus seen that along their western edge the coal-bearing beds lie at a high inclination with an easterly dip. Apparently, however, this dip flattens rapidly further east, and it seems probable that over the greater portion of the area over which the coal-beds occur, they lie practically horizontally. On passing up Valentine Creek from the position of the shaft, the dip flattens rapidly, till at a point about 300 yards from the shaft, where the creek takes a bend to the west, the dip is only about 45 degrees. This portion of the creek shows outcrops of shale and coal, the latter in seams running up to 6 feet in thickness. About a quarter of a mile above this point another outcrop of coal shows a dip of only 20 degrees.

A bore has been sunk about 300 yards east of the outcrop in Waterpark Creek in an attempt to cut the coal at a depth. The approximate position of the bore is shown on the map. The record of the strata passed through in the bore as handed to me by the borer is as follows:—

Depth. Ft.	in.	Thickness of Strata. Ft.	in.	Description of Strata.
3	0	3	0	Red sandstone
33	0	30	0	Decomposed sandstone and clay, with some quartz rubble in it
33	6	0	6	Hard grey shale
34	0	0	6	Coal
36	0	2	0	Grey sediment
99	0	63	0	Coal with bands of sediment and black carbonaceous mud alternating with each other. Fully five-sixths of the strata passed through being coal, some of which was much harder than other, notably a 2-feet seam at 77 feet, and a 5-feet seam at 91 feet
108	0	9	0	Carbonaceous mud, with streaks of coal in it.

Judging from this record, and the steep dip of the outcrops on Waterpark and Valentine Creek, it seems probable that the shaft seam and the large seam below it have not been reached in this bore. The coal with bands of sediment probably represents the alternating outcrops of shale and coal found above these seams on Valentine Creek. A portion of the core from the bore, taken out with the auger, and consisting of coaly shale, shows that the dip of the strata at the bore is much less than at the outcrop, being about 45 degrees. It apparently flattens quickly further to the east, for at No. 1 bore, shown on Map 2, I am informed that the strata were practically horizontal. No. 1 bore, though 154 feet deep, does not seem to have reached even the upper coals, which are here no doubt considerably deeper below the surface than at No. 2 bore. The following is the record of the strata passed through as given to me by the borer:—

Depth. Feet.	Thickness of Strata. Feet.	Description of Strata.
3	3	Soft red sandstone
33	30	Soft decayed sandstone
69	36	Soft black sediment or shale
72	3	Hard brown shale
76	4	Stiff black sediment
147	71	Hard shale, sometimes brown or black
153	6	Dark chocolate shale with 2 inches of black shale or coal
166	13	Black sediment or shale.

Several exposures of sandstones along the course of Sandy Creek show that the coal strata are pretty nearly horizontal in that neighbourhood also. Outcrops of sandstone in the neighbourhood of No. 1. bore (shown on Map 1) are also horizontal, and it is apparently only where the beds are in contact with the granite along the south-western boundary of the field that they are at all steeply inclined. The information to be gained as to the disposition of the beds over the greater portion of the area is, however, very meagre, and the "lie" of the rocks can only be judged with some considerable uncertainty.

The boring that has been done has not been sufficient to indicate how much of the area mapped as covered by coal beds is underlain by the seams found outcropping on the west, but it seems probable that they will be found to underlie a considerable portion. The thickness of the seams is phenomenal for Queensland, as is the quality of the coal. Its physical character and composition show it to belong to the class of hydrous or brown coals. It is dull brownish black in colour, compact and finely laminated in structure, and breaks up on exposure to the air into irregular lumps, with a sub-conchoidal fracture It ignites with difficulty and burns with a smoky flame, giving off a tarry odour. Analyses show it to be characterised by a high percentage of moisture and of volatile hydrocarbons. This is the first instance of the occurrence of a true brown coal in Queensland. The commercial value of the mineral as fuel is discussed below. Up to the present no evidence, either stratigraphical or palæontological, is forthcoming to allow of the age of these beds being determined, except that they are evidently newer than the Permo-Carboniferous (?) slates and schists by which they are surrounded.

COMMERCIAL VALUE OF THE WATERPARK CREEK COAL.

The following two analyses of samples of Waterpark Creek coal—No. 1 from the shaft on Valentine Creek, and No. 2 from the outcrop on Waterpark Creek—were made at the Government Chemical Laboratory:—

Analyses of Waterpark Creek Coal.

	No. 1. From Shaft on Valentine Creek.		No. 2. From Outcrop on Waterpark Creek.	
Moisture	10·25		...	10·72	
Volatile hydrocarbons } Total combustibles Fixed carbon }	41·38 38·78	80·16	...	40·76 42·87	83·63
Ash	9·59		...	5·65	
	100·00			100·00	
Sulphur	1·16			1·20	

Coke, non-caking; ash, white.

These analyses show that the coal is a fairly good quality of brown coal, comparable in many respects with some of the best brown coals worked in New Zealand. It is, however, evidently distinctly inferior, either as a steam coal or for general purposes, to the bituminous coal in general use in Queensland, obtained from the Ipswich, Burrum, and Clermont fields. The total percentage of combustibles is only 80·16 per cent. and 83·63 per cent. as against an average of about 90 per cent. for the latter coals, while the proportion of fixed carbon is much too low for a good steam coal. The high proportion of volatile combustibles indicates a coal likely to be a very wasteful burner in the ordinary type of furnace, constructed for the combustion of less gassy coal. Such coals, high in volatile combustibles, usually burn with a smoky flame, with a consequent waste of heating power. They quickly deposit soot in the boiler tubes and flues, causing further dissipation of heat, and necessitating frequent cleaning. The Ipswich coal shows an average of from 60 per cent. to 70 per cent. of fixed carbon in a total of almost 90 per cent. of combustibles, a ratio of fixed carbon to volatile combustibles of nearly twice that found in the Waterpark Creek coal.

The heating value of a coal can in many cases be fairly well judged from the proportion of fixed carbon that it contains. The heating value of the Waterpark Creek coal should be equal to about 10,000 British thermal units per pound of coal, judging by a comparison of its proximate composition with that of similar coals whose heating values have been determined by calorimeter tests. The average heating values of some of the most used of the Ipswich and Burrum coals were determined with the calorimeter by the late Mr. Robert Wilson, Engineer on the Government Steamer "Otter," in 1892.*

Mr. Wilson found an average of 13 997 lb. of water evaporated per lb. of Ipswich coal, and 14·18 lb. per lb. of Burrum coal. These values are equivalent to a heating value for these coals of about 13,500 B.T.U. The values compare very well with those given for American coals of similar composition, so that 13,500 B.T.U. may be taken as representing roughly the heating value of Queensland bituminous coals. On this basis the heating value of the Waterpark Creek coal is to that of coals at present used in Queensland as 10 is to 13·5. In the case of gassy coals, however, the amount of available heating power lost in the furnace through incomplete combustion and other causes is so much greater than is the case with good steam coals, such as those from Ipswich and Burrum, that the ratios between the actual heating effects in practice may be considerably less than as 10 is to 13·5. It is consequently impossible to arrive at a correct estimate of the value of such a coal for fuel purposes without a practical test of its heating value with a few hundredweights of the coal in an ordinary furnace In the case of the Ipswich and Burrum coals a series of such tests was made in 1892, on the Government steamer "Otter," by Mr. Robert Wilson, and the results compared with those given by two standard New South Wales coals, one from the Northern and the other from the Southern coalfield. These results were valuable as demonstrating that the steaming qualities of Queensland bituminous coals then in use compared very favourably with those used in New South Wales, when care was taken to obtain them free of dirt and in good condition. It would be of great advantage if the practical heating value of the Waterpark Creek coal could be determined in a similar manner; for though it is certain to be considerably lower than that of other Queensland coal, its proximity to the coast and the Central Railway, and the apparently easy conditions under which much of it could be mined, might for many purposes be found to compensate for its deficiency in heating power. I understand that a few tons were burned as a trial in a small vessel in the Fitzroy River, and it is stated that the coal behaved well and burned without smoke. Such tests, however, are of little value without some measurement of the heat developed by the coal over a few hours' run. The establishment of some means of testing the fuel value of new coals in Queensland before expense is incurred in opening up the fields could be accomplished with little expense, and should be of great advantage. Such determinations are made in most other countries and have proved of great benefit. At present the only means of arriving at any idea of their fuel value is the somewhat unsatisfactory one of a proximate chemical analysis. This method, though it is often a very fair index of the value of a coal to the chemist, does not appeal very forcibly to the ordinary coal user, and may easily be very wide of the mark in the case of a very gassy coal. Possibly the services of a competent engineer could be obtained to make a report on the heating value of a few tons of the Waterpark Creek coal, similar to that made by Mr. Wilson on the Ipswich and Burrum coals, or of any other coal known to occur under workable conditions. If this could be done, the exact heating effect of a ton of such coal could be compared with that of a ton of any of the coals now in use, and its market value determined accordingly. Such a determination would be much more satisfactory than a rough guess at the practical heating value from a knowledge of the proximate constitution, or even from a determination of the heat developed in a calorimeter.

* See Queensland Coal: Its economic value as a steam coal, by Robert Wilson, engineer, s.s. "Otter;" published as an appendix to geology of the West Moreton Coal Fields. G.S.Q. publication No. 147. Brisbane: By Authority, 1898.

The Waterpark Creek coal, being a gassy coal, may very well turn out to be suitable for some purposes for burning with the anthracitic coals of the Dawson River, when those coals come into general use.

The fact that brown coals of very similar character to that found at Waterpark Creek are used extensively in some parts of New Zealand shows that they possess considerable value when the better classes of coal can only be obtained at some expense. The following table shows the character of some of the most extensively mined of the New Zealand brown coals, as well as the output for 1900, and the total output to the end of that year, of the mines from which they are obtained.

NEW ZEALAND BROWN COALS.

Analyses and Output of the most Important Mines.

Mine.	Moisture.	Volatile Hydrocarbons.	Fixed Carbon.	Ash.	Total Combustibles.	Output for 1900 in tons.	Output to end of 1900 in tons.
Kaitangata Mine, Otago	19·61	37·25	39·41	3·73	76·66	112,455	1,369,562
Shag Point Mine, Dunedin	16·57	33·76	43·15	6·58	76·85	21,201	386,859
Night Caps Mine, Southland	21·38	45·96	29·30	3·36	75·26	27,840	266,718
Taupiri Extended, Waikato, Auckland	...	...	...	...	...	21,742	633,654
Ralph's Taupiri Mine, Auckland ...	...	...	...	...	...	36,828	79,221

A comparison of these analyses with those of Waterpark Creek coal shows that the latter coal resembles the New Zealand coal in character. Taking the Kaitangata coal, the percentage of combustibles is somewhat lower than is the case with the Waterpark Creek coal, but the fixed carbon is about the same. The moisture is somewhat higher, but the ash lower. The total output of coal classed as brown coal from New Zealand for 1900 was 339,786 tons as against 673,862 tons for bituminous coal.

The markets for these coals are, however, purely local, and their working is confined to districts where a good demand for household and general steam purposes occurs in the immediate neighbourhood of the mine. They cannot compete with the bituminous coals of Greymouth and Westport at places where the cost of freight from the mines is anywhere near equal for both. In the same way it will be impossible for the Waterpark Creek coal to compete against other superior coals in any market where it has not a decided advantage in easy accessibility and cheaper transport. The nearest market likely to be available is Rockhampton and the Central Railway line. The Central Line obtains its coal from the Ipswich, Burrum, and Clermont fields. The two former involve rail journeys of 18 and 20 miles respectively, and then sea journeys of 200 and 400 miles. In the case of Clermont the coal has to be carted some 13 miles to the terminus of the line, at a cost of about 10s. a ton. If the Waterpark Creek coal could be brought in barges from the creek to the Central line at Emu Park or Broadmount, there is no doubt that the coal could be supplied to the Central line and Rockhampton at a much lower cost than any of these coals. This would mean a sea journey of 20 miles in the one case and 40 miles in the other, and it is extremely doubtful whether the entrance to Waterpark Creek could be negotiated by craft large enough to navigate these waters except in the calmest weather. To bring the coal by rail to the Central line would mean the construction of at least 27 miles of railway line, involving an initial outlay which would not be warranted by the quality of the coal and the probable market for it.

Two other schemes may be noticed. The first is to build a tramline some 12 miles in length to the southern end of Port Clinton to a point to which the Admiralty chart shows a channel from the entrance having a minimum depth of 1¼ fathoms at low-water springs. This depth might be negotiated at flood tide, but can hardly be considered sufficient for collier trade. The foreshore at this point also is bad, consisting of wide mangrove flats. I am informed, too, by Captain Jones, Government Inspector of Shipping, that the entrance to the port is dangerous in rough weather, there being a nasty break on the bar at the entrance. Captain Jones points out that the chart suggests that Head Creek affords better facilities for shipping, showing a good channel, with a minimum depth of 3¼ fathoms, to a point near the head of the inlet, on its western side, situated a distance of about 14 miles from the outcrops on Valentine Creek, with a good foreshore to the deep water. Both these schemes, however, involve an initial outlay in tramline construction which is not warranted by the quality of the coal and the prospects of a market, cheap transport to a market being a *sine quâ non* in the case of a coal of the quality of that found up to the present at Waterpark Creek.

COALS OF SIMILAR CHARACTER IN GERMANY AND VICTORIA.

Brown coals have been mined in Germany for a number of years. In the *Mineral Industry* for 1900, an account is given of two main uses to which these coals are put. These are (1) for briquette making, and (2) for the production of various mineral oils, creosote, asphalt, paraffin, and other products, by means of destructive distillation of the coals in specially designed retorts. In 1898 over 26,000,000 tons of brown coal were mined in Prussia, the centre of the briquetting industry, valued at nearly £3,000,000, and from this over 3,000,000 tons (metric) of briquettes were manufactured. In Saxony, the centre of the distilling industries, 1,180,000 tons of brown coal were mined, from which about 60,000 tons of coal tar, and another 60,000 tons of various coal tar products, were obtained.

In Victoria great quantities of brown coal are known to occur, but up to the present but little use has been made of them. Those from Narracan, in the Gippsland District, and from Dean's Marsh, have been examined by Mr. Henry C. Jenkin, A.R.S.M., the Government Metallurgist, and their chemical composition and possible uses fully reported on. The Narracan coal contains as much as 39·4 per cent. of loosely held moisture. Speaking of its possible uses, Mr. Jenkin says:—

"As regards the utilisation of the fuel, it may at once be stated that it is entirely unsuited for the manufacture of briquettes, except with an expensive admixture of pitch, the secret of good briquetting being to bring the mass into such a state that upon being used as fuel the briquette will, when heated in the fire, not fall to pieces, but burn in a more or less coherent form as coke. This coal is not itself capable of coking, as the pitch yielded in careful destructive distillation is only 0·7 per cent. of the whole, and

quite insufficient to act as a cementing material to the charcoal-like residue to which heating reduces the coal. It might be possible to make a sound briquette of a little of the coal by using the pitch from a much larger quantity treated by destructive distillation, but this would be found to entail far too great a cost, and even then the briquette would be 'tender' in the fire and fall to pieces easily.

"The correct manner in which to utilise this fuel as a source of power on the industrial scale is to first convert it into gas; this could be done in suitable gas producers, with retorts not much differing from the apparatus used in the Shale Oil Industry. It would, however, be necessary to design it specially, in order to get the best effects out of a given fuel, and this it will give me much pleasure to do when occasion should demand, or when the investigation into the properties of the fuel is further advanced. The retorts can be arranged so as to yield a gas similar to that described above, together with the tar and ammonium sulphate, and would dispose of the carbonaceous residue as producer gas, the latter being used as a source of heat by which to work the apparatus. The rich gases could be utilised in gas-engines, and the power used for various industries on the field, as for the generation of electric currents for the electrical industries.

"There would be one other solution of the problem in the use of the fuel in ordinary gas producers without more than a partial recovery of the by-products; but it must be emphasised that in whatever way use is made of the material, it should be done within a mile or so of the mine for the best effect, and within reach of the mine tramway."

The proximate analysis of the Dean's Marsh coal (without drying) showed—

Non-condensible volatile products	13·9 per cent.
Condensible volatile products between 20 degrees C. and 100 degrees C., including 19·99 per cent. water	27·4 „
Condensible volatile products above 100 degrees C.	8·6 „
Carbonaceous residue, including 4·5 per cent ash	50·2 „

This analysis shows that the Dean's Marsh coal is very similar to the Waterpark Creek coal in proximate composition, though the examination of the latter was not as detailed as that of the former. The calculated yield of gas is given as from 6,200 cubic feet to 12,000 cubic feet per ton of wet coal, the gas being of such a composition as to be more serviceable for heating than for illuminating purposes. And Mr. Jenkins concludes, "Altogether this is a much more favourable fuel for the general purposes of utilisation" than the Narracan coal; "the utilisation of this fuel should take place as nearly as possible to the mine, and whilst the so-called by-products of the tar offer a wide field to industry, and can incidently be recovered, the utilisation of the lignite as fuel should be made in the retort and gas producer, singly or in combination."

Mr. Jenkins' report is dated 28th June, 1901, and apparently the question of how the Victorian brown coals are to be utilised is still an open one.

In lectures delivered in London, Mr. J. Stirling, Victorian Government Mining Representative there, after a study of the uses to which brown coals are put in Germany and Austria, advocates the utilisation of the Victorian brown coal by employing the same methods of manufacturing the raw material into briquettes, and by distillation of the oils, paraffin, and various by-products, in the case of the more highly oleiferous portions. Mr. Stirling maintains that this could be done with a good margin of profit, and quotes figures in support of his argument.

Mr. Stirling mentions that in the case of the brown coal in the Latrobe Valley, Gippsland, a bore put down by the Government at Maryvale proved a thickness of 780 feet of coal down to a depth of 987 feet, the proportion of fixed carbon in the coal, as shown by analysis of the core, increasing from 36·75 per cent. in the upper beds to 48·30 per cent. in the lower beds. Some improvement in the Waterpark Creek coal may therefore take place in the seams lying below that opened up in the pit on Valentine Creek, but I do not think it will be sufficiently great to materially affect the usefulness of the coal. These lower seams were not sufficiently well exposed to allow of a representative sample being taken for analysis.

CONCLUSION.

In conclusion, although the coal beds at Port Clinton do not cover a very large area, they are still probably of sufficient extent, considering the apparently great thickness of the seams, to contain a very large quantity of coal. The data available at present are quite insufficient to enable an estimate being made of this amount that would have any practical value. The coal is handy to ports, which could no doubt be made serviceable with little expense.

The coal is not a good class of steam coal, and the market for such a coal in its natural state is not very promising, unless it can be landed at Rockhampton or on the Central Railway line at a very cheap rate. The establishment of such industries as those found in Germany, and contemplated by Mr. Jenkins and Mr. Stirling for Victoria, involve the employment of such an amount of capital and expert knowledge that it will no doubt be some years before an attempt is made to utilise the coal in any of these ways. There is no doubt, however, that there is here a large amount of valuable fuel lying ready for men with sufficient capital and skill to turn it into a useful commodity.

COASTAL SAND-DUNES AND WATER SUPPLY.

From Waterpark Point northward to Cape Clinton, a distance of 24 miles, the coast is formed by sand-dunes, broken here and there by cliffs and promontories of upturned metamorphic sandstones or granite. These sandstones extend back to distances of 4 and 5 miles from the coast, and must be in places quite 200 feet above the sea-level. In places they are heavily timbered with box and stringy bark, and in other places with bracken and other coast plants. This line of hills presents a well-defined escarpment to the west, and is succeeded by comparatively level country, except in the neighbourhood of the Peaks. At the foot of this western escarpment are a number of large swamps which drain in a westerly direction

into Waterpark Creek. These swamps are evidently kept filled by the soakage from the stretch of sand-hills along the coast, the sand-hills being of such a nature that practically the whole of the water which falls on them in the form of rain is absorbed, and, percolating slowly through the great thickness of sand, bursts out in springs at their base, both along the coast and into the series of swamps along their western margin. North of the Peaks the whole of the water draining from these hills finds its way back to the sea by a stream flowing north into Port Clinton past Mount Solitude, or by Waterpark Creek. South of the Peaks the swamps drain out by a number of small swiftly running creeks into the lower reaches of Waterpark Creek, the largest and most northerly of which is Sandy Creek. Both Waterpark Creek and Sandy Creek are streams of beautiful running water, which must bring down a very considerable volume in the course of the year, and are permanent through the driest seasons, being kept continually supplied by the slow percolation through the large area of sand-hill country along the coast.

KEROSENE SHALE.

North of Fishing Point several pieces of an impure kerosene shale were found lying on the beach, and large blocks have frequently been found at odd times in this locality. The sample found was evidently too impure to be of any value. These pieces of shale may possibly have been washed up on the beach, but it seems much more likely that they are from the coal-beds of Waterpark Creek, and that a tongue of these beds extends up Sandy Creek towards the sea at Fishing Point, being hidden by the sand-dunes in this neighbourhood, and that the shale is exposed now and then on the beach in heavy weather, when portions of it are torn off by the waves.

[No. 174 of the Geological Survey Publications.]

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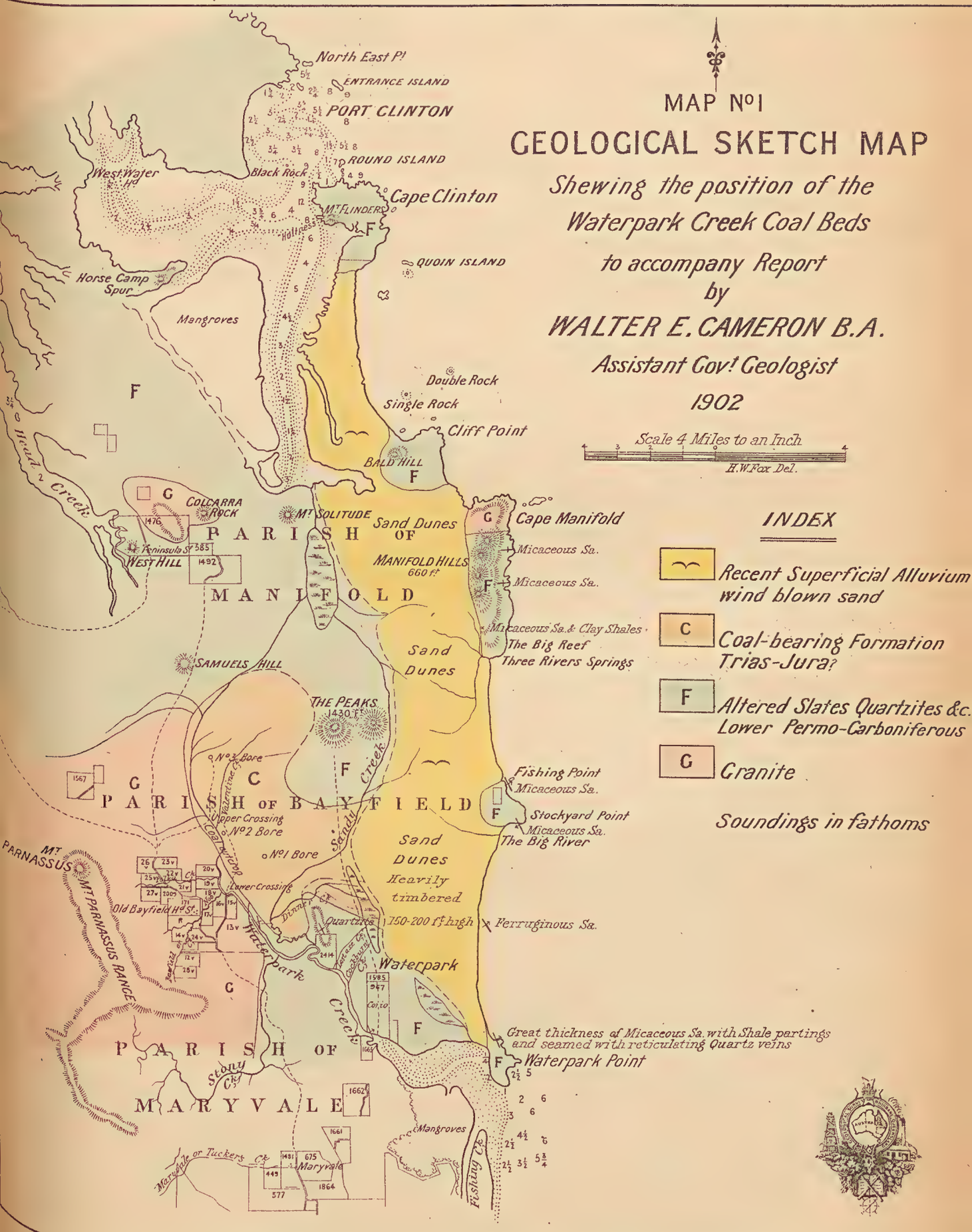

MAP No I

GEOLOGICAL SKETCH MAP

Shewing the position of the Waterpark Creek Coal Beds

to accompany Report

by

WALTER E. CAMERON B.A.

Assistant Govt Geologist

1902

Scale 4 Miles to an Inch

H.W.Fox Del.

INDEX

- Recent Superficial Alluvium wind blown sand
- C — Coal-bearing Formation Trias-Jura?
- F — Altered Slates Quartzites &c. Lower Permo-Carboniferous
- G — Granite

Soundings in fathoms

By Authority: GEORGE ARTHUR VAUGHAN, Government Printer, William street, Brisbane.

MAP No 2

GEOLOGICAL SKETCH MAP

Shewing the position of the Waterpark Creek Coal Beds

to accompany Report

by

WALTER E. CAMERON B.A.

Assistant Govt Geologist

1902

Scale of Miles

0 ¼ ½ ¾ 1 2 3 4

H.W. FOX, DEL.

INDEX

- Recent Superficial Alluvium wind blown sand
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Soundings in fathoms

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VICTORIA

1902.

QUEENSLAND.

THE CLERMONT GOLD FIELD,

WITH A DESCRIPTION OF DRY-BLOWERS AND OTHER IMPROVEMENTS IN ALLUVIAL GOLD-SAVING APPLIANCES,

BY B. DUNSTAN, F.G.S., ASSISTANT GOVERNMENT GEOLOGIST.

[With 2 Maps, 1 Plan, and 10 Plates.]

Presented to both Houses of Parliament by Command.

LETTER OF TRANSMITTAL.

Geological Survey Office,
Brisbane, 24th April, 1902.

SIR,—I have the honour to forward herewith Mr. Dunstan's Report on the Clermont Gold Field, with a description of Dry-blowers and other Improvements in Alluvial Gold-saving Appliances.

I have, &c.,
WILLIAM H. RANDS,
Government Geologist.

The Honourable The Minister for Mines, Brisbane.

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INTRODUCTION.

The basis of the present Report on the Clermont Gold Field was the work accomplished by Mr. Rands during the year 1886, when he made an examination of the auriferous reefs and alluvial deposits known up to that time. Since then many developments have taken place, necessitating further inspections by Dr. Jack in 1894 and 1897, and the more recent extended examination of the writer in 1901.

Both Mr. Rands' and Dr. Jack's Reports* will be frequently quoted, as many of the mines they have visited could not be inspected, and their reports, containing useful information, are out of print and are not available to the general public.

The physical features of the country around Clermont have been dealt with in a previous Report on the Coalfields of Clermont,† and as this is a recent publication there will be no necessity to repeat the information here.

GEOLOGICAL CONSIDERATIONS.

The geological formations of the Clermont District have been described by the writer in the above Report (*l.c.*: pp. 2-7), and therein references have been made to the granite, slates and schists, quartz reefs, intrusive rocks, fossiliferous limestone, marine beds, coal measures, "Billy," Tertiary basalts, and the auriferous alluvial deposits. Extracts will be taken from that Report, as the information concerning the geological features will be of special use in the present one.

Referring to the slates and schists, it is stated that :—

"Slates and schists surround the Coal Measures on all sides. The town of Clermont is partly situated on chloritic and talcose slates, and the country to the west, north-west, and south-west for several miles is mostly slates and schists of various kinds. On the Drummond Range to the north and north-east the slates are exposed in places above the level of a great flow of basalt. . . . At the Blair Athol Coal Field in the Newcastle air-shaft the seam of coal rests on the inclined surface of slates. . . .

"There is considerable diversity in the mineral composition of the slates as they are in places talcose, micaceous, chloritic, hornblendic, siliceous, or clayey.

"Near the watercourses, particularly in Sandy Creek, they have suffered very little weathering, but on the hills and ridges they are so much decomposed that it is difficult to say whether they are very old deposits, or recently formed deposits from the débris of the old ones.

"Their age has not been determined, palæontologically or stratigraphically, as no evidence has been forthcoming, so far, to indicate what position they should be assigned to, further than that at Douglas Creek a bed of fossiliferous limestone occurs close to the slates and schists there, whose relation, however, to the latter rocks has not been established.

"Mr. Daintree refers the slates to the 'Lower Silurian Series, or even to the still older metamorphic system of Victoria.'

"The agency which altered the mineral composition, although perhaps not the chemical composition of the old sedimentary rocks, also produced changes in their geological position, and in consequence small fissures have been made and subsequently filled with quartz to form reefs and veins.

"The occurrence of the reefs here is a matter of importance, as some have proved very rich in gold ; but attention was not paid to them. . . . .

"The denudation of these reefs and veins has been going on from a time prior to the formation of the coal deposits, and the gold shed from them has been accumulated in the old channels at Hurley, The Springs, Wild Cat, &c., of the Coal Measure Period, and in the present innumerable watercourses which at the present time lead into Sandy Creek at Clermont."

---

* 1. The Geology and Mineral Deposits of the Country in the Vicinity of Clermont. W.H.R. By Auth. Bris. 1886. G.S.Q. 27.

2. Annual Progress Report of the Geological Survey for the year 1894. By Auth. Bris. 1895. G.S.Q. 103.

† The Permo-Carboniferous Coal Measures of Clermont and Associated Formations. B.D. By Auth. Bris. 1900. G.S.Q. 148, p. 2.

These remarks need no amendment in the present Report, except to state that the slates were found to be chromium-bearing in a number of places. These chrome-bearing slates were supposed to contain copper on account of their bright green colour, but of this metal there has not been found a trace in any of the samples tested. They occur with more or less quartzite and vein-quartz at Deep Creek, near the junction of Deep Creek and Long Gully, on the bottom of the Deep Creek Lead, also at the Dynamiters' Claim on the Wild Cat Lead, at the Bower Bird Lead, at the end of the Dead Horse Lead near the Railway Reserve, and on the top of the dividing ridge near the Palm Tree Surface Lead, all the positions of which are shown on Map 2 accompanying this Report. The chrome-bearing rock may not be of any economic importance as the percentage of chromic oxide is very small, but it is nevertheless interesting in being so easily and commonly mistaken in its appearance for the green carbonate of copper.

Referring to the "billy" in the same report (pp. 5, 6), the statement is made that:—

"A bed of quartzite caps the Coal Measures in many places around Clermont. It is usually even-grained and semi-vitreous, with a smooth, conchoidal fracture, but occasionally it is found gritty and ferruginous. Sometimes the bed occurs as a well-defined stratum, sometimes as masses broken up into large boulders by spheroidal weathering, but commonly as small boulders and pebbles in recent alluvial deposits.

"The structure and surroundings of the quartzite, or 'billy,' as it is locally and conveniently termed, suggests that the sandstone from which it was formed has not been altered by the general processes of metamorphism. Many places have been inspected, and special attention was given to this matter that some light might be thrown on its origin, but, so far, it has not been found (either as a bed, or as boulders or pebbles in beds) in the Coal Measures, and apparently it is of more recent age.

* * * * * * * *

"Near the residence of Mr. Grant, at Apsley Creek, a black soil flat covers a flow of basalt, boulders of which are to be seen on the surface. Protruding through the basalt and black soil, and above the level of the surrounding country, occurs an isolated hill of white 'billy,' and its close association with the basalt suggested the change of the sandstones into a quartzite being only superficial and due to the effect of molten lava, but the present level of the plain very evidently is about the same as that of the lava when it was molten, so that the 'billy' was always exposed high above it, and was never covered completely by the basalt.

* * * * * * * *

"At the crossing of Sandy Creek, near the cemetery, at Clermont, a bed of 'billy' is exposed covering a gritty fireclay which belongs to the same series as the rocks of Quarry Hill. The bed has been somewhat disturbed, as it forms an *anticline*, but basalt or other igneous rocks are not to be seen, and nothing to indicate that the change has been produced by *contact metamorphism*. The gritty fireclay below the 'billy' has not been perceptibly altered, although it is in close contact with the 'billy,' and apparently has been subjected to the same action. In the case of the 'billy,' the cementing material, silica, has bound the clean grains of sand together without any clayey substance interfering, while in the case of the fireclay the particles cemented together being partly composed of clay might have become disintegrated by subsequent weathering.

"Where the 'billy' is ferruginous, the silica cementing the sand grains is charged mechanically with fine particles of both red and yellow oxides of iron.

"At numerous other places 'billy' occurs, particularly at Quarry Hill, Wild Cat Lead, Wolfang Creek, and Blair Athol.

"With regard to the age of the 'billy,' all the information to hand is of a negative character. It has not yielded fossils at Clermont, although similar quartzites occur in other districts which have been classed as Desert Sandstone. It is not so young as the basalt, as in several localities this rock covers not only 'billy' but also beds containing boulders of it."

At one part of the Black Ridge, the position of which is northerly from Clermont (see Map 1), the "billy" exists as a hard, compact bed, in places fourteen feet thick, and most difficult to penetrate to reach the gold-bearing wash below. It occurs as a belt several miles long and in some places several hundred yards wide, and appears to have occupied at one time the channel of an old stream. From the Black Ridge it has both a northerly and southerly extension.

Concerning the basalt the following remarks are made by Mr. Rands in his Report (*l.c.*: page 2):—

"I obtained no evidence in the district from which the exact age of the basalt could be determined. It appears, however, certainly to be newer than the carboniferous formation. At Blair Athol the basalt is seen overlying the carboniferous strata. Again, at Cement Hill there is a drift of carboniferous age containing the fossil *Glossopteris*. A similar drift is also met with a short distance east of Cement Hill, and here an old alluvial lead (the Victoria Lead), running in a northerly direction from the summit of a low round knob, has sometimes cut through this carboniferous drift. This lead at the bottom of the hill has been traced underneath the basaltic plains. A shaft sunk on this lead in the basalt went through—

	Feet.
Basalt	40
A gravelly quartz drift (the bottom three or four feet of which contained the gold, forming the washdirt)	60
Drift, consisting chiefly of small, more or less angular, pebbles of micaceous and sandy schists, with a little quartz; this is called by the miners 'tish'	79 (not bottomed)

It would thus appear that the drift of the Victoria Lead was newer than the carboniferous drift, and that the basalt was of a still later date than the Victoria Lead."

The writer, in examining the country in connection with the occurrence of coal measures, states (*l.c.*: page 6) that:—

"A flow of basalt has taken place to the north and east of Clermont on an extensive scale, but, being outside the scope of the work, no attempt was made to trace it to its source. The Drummond Range contains several prominent peaks, around which the basalt extends for miles. On the latest edition of the Geological Map of Queensland, and also on previous editions, these peaks have been shown as volcanic peaks, but from the records of the wells sunk by Mr. Grant for the Clermont Divisional Board, and also from the wells sunk on Wolfang, it seems that in some cases at least these very sharp peaks are the outcrops of tilted beds of slate around which the basalt has flowed, and are not volcanic vents.

"The slope of the surface of the basalt flow is almost imperceptible, but apparently inclines from north to south. On the western edge of the basalt the flow has been confined in part by the slate formation extending from The Springs to Clermont. At Blair Athol the basalt has filled or partly filled old watercourses, and at The Springs and other places the gold drifts—Permo-Carboniferous and more recent—have been overwhelmed by streams of this lava."

Since that examination very little additional information has been gathered concerning the basalt.

Referring to the Tertiary Deposits, several new features have been brought to light. In the above quoted report it is stated (*l.c.*: page 7) that:—

"Since the formation of 'billy' no regular sedimentary deposits have accumulated, but instances are common in the Clermont District where the quartz veins, slates, and schists of the older formation, and the sandstone, shales, 'billy,' &c., of the younger, have become disintegrated and have formed irregular deposits.

"Previous reference has been made to the auriferous deposits occurring in the Coal Measures, but the younger deposits, although sometimes difficult or even impossible to distinguish from the older ones, are usually to be indicated by the presence of boulders and pebbles of 'billy,' and by the absence of shales, coal bands, and the fern *Glossopteris*. The old alluvial gold deposits at The Springs are white and more or less clayey, while the recent deposits are ironstained.

"At The Springs, the 'billy' occurs on the bottom of the *younger* 'lead' with the gold, and with basalt (dolerite) covering it. In other places at The Springs the gold is found in the old *Permo-Carboniferous* lead, and also above this in the more recent Tertiary 'lead.'

"The occurrence of fossil remains of animals in a drift or lead at 'Flyspeck,' on McDonald's Flat, near Clermont, has been referred to previously by Mr. Jack (*l.c.*: page 10), and during the recent visit to the locality other bones and teeth were obtained."

These deposits have received attention for some long time past and, in view of what might be found later on, the positions of most of them have been fixed and are shown on the accompanying maps.

Map 1 is a sketch of a portion of the Clermont district, showing the position of the leads and reefs and the general features of the country they are in. The area embraces The Springs and the Black Ridge to the north, the Western and Brigalow Creeks to the north-west, and the country as far south as McDonald's Flat. The map is on a scale of one and a-half miles to the inch.

Map 2 is an enlarged portion of Map 1—the south-eastern corner—and embraces the country from Clermont, at the latitude of Quarry Hill, to the Yellow Waterholes south of McDonald's Flat. It shows in detail the position of all the leads in this part of the district, together with the outcrops of the reefs at present being worked as well as those which have been abandoned. During the work of fixing the position of the leads and reefs a large number of aneroid readings were made from which the topographical features in contour lines shown on the map have been constructed. By a study of these contour lines the relation of the leads to one another, and to the reefs adjoining them in some cases, becomes much clearer, and for general purposes should prove useful. The scale of the map is seventeen chains to one inch.

It is to be regretted that other portions of the goldfield, outside the area covered by Map 2, could not be similarly traversed, but circumstances would not permit of this being done.

ALLUVIAL DEPOSITS.

(Permo-Carboniferous to Recent.)

The great number of alluvial deposits in the district precludes more than a general reference to each, except where some special feature has to be described or on which no previous report has been furnished.

The leads north-westerly from Clermont, in the vicinity of The Springs, Black Ridge, Hurley's and Venus will first be described, then those closer to Clermont on the north side of Sandy Creek, next the leads on the south side of Sandy Creek around the Wild Cat and Dead Horse Leads and around McDonald's Flat, and lastly those between McDonald's Flat and Copperfield.

The Springs Leads.

The positions of these leads are eleven miles directly N.N.W. from Clermont, and are shown on Map 1. They were examined by Mr. Rands in 1884, who states (*l.c.*: pp. 2-3) that:—

"In the neighbourhood of The Springs, on a low easterly spur from the range, nearly a score of gullies have been worked and have given good returns. The claims in Prospector's Gully, Scrubby Gully, and St. Patrick's Gully, were especially rich. The gold was coarse but round, nuggets of two ounces in weight occurring. The schists here dip to the west, and are completely surrounded with basalt.

* * * * * * * * *

"The Victoria Lead has been perhaps the richest deposit of gold in the district. At the summit of the hill where the workings on it started, the washdirt was only fifteen to twenty feet deep. About three-quarters of a mile to the north, where it ran under the basalt, it was 100 feet deep; its average width is from twenty to thirty feet. A thirty-ounce nugget was obtained from near the head of the lead. The washdirt is said to have averaged one and a-half ounces to the load all the way through, and twenty-four loads in one part yielded eight ounces per load.

"The All Nations Claim—the furthest north and under the basalt—was abandoned, owing to the difficulty the miners experienced, without capital to work with, of keeping back the water. Good gold was obtained as far as it could be followed.

* * * * * * * * *

"Cement Hill is a low round boss-shaped hill lying about eleven miles north of Clermont. It covers an area of about three-quarters of a square mile. It is at present being worked by two or three companies. The hill consists of—*Firstly*, from fifteen to thirty feet in thickness of a conglomerate, composed of boulders and pebbles of schist and also small quartz pebbles; the whole cemented together by a clayey cement formed from the disintegration of the schist itself. This conglomerate is soft, but very tough to work in. The bottom four or five feet of this conglomerate forms the washdirt in which the gold is found. The conglomerate is of a red colour in parts, from the infiltration of oxide of iron. *Secondly*, underlying this conglomerate is a fined-grained silt or shale, from one foot to four feet in thickness, termed by the miners 'dig,' which, being softer and more easily worked than the conglomerate, is cut away to facilitate the bringing down of the wash above. This shale dips from 5 degrees to 25 degrees in a westerly and south-westerly direction into the hill from its eastern side, the side on which operations have commenced. The silt is micaceous, and has in places a very greasy feel to the touch; in other parts again it passes into a fine-grained micaceous sandstone. Numerous well-preserved impressions of the fern *Glossopteris* occur in this silt; there are also other plant remains, but the *Glossopteris* was the only distinct form I found, and that was very numerous . . . And *lastly*, underneath this silt or shale is another drift, of a much finer character than the upper one, consisting of small schistose peobles, but containing much more quartz, the quartz pebbles often predominating. The constituents of this drift are not on the whole so much rounded. This drift is locally termed by the miner, 'tish.' In some parts of the hill the shale rests immediately on the schists, but oftener on the 'tish'; it is in places over forty feet in thickness; a shaft near the southern end of the hill went that distance through it without bottoming it. No gold has been found in this lower drift. Below this again are the schists which can be seen cropping out in the hill itself and in the gullies around it; they dip at 35 degrees to west-south-west.

* * * * * * * * *

"With respect to the prospects of working this deposit remuneratively, the bottom four or five feet is said to contain on an average about five or six pennyweights of gold per ton. The gold is, as a rule, very fine, but specks, from a grain to a pennyweight, are often met with. Mr. Macgregor, the manager of one of the claims, informed me that after working for some considerable time their stone averaged about five pennyweights per ton, and that that amount did not pay them; but the battery (five head of stamps) was three-quarters of a mile from the claim; the carting of the stone that distance came to over half-a-crown per ton, which, in itself, would be sufficient to render a deposit containing so small an amount of gold unpayable. I hear that Mr. Macgregor has, since my visit, suspended operations."

During the recent inspection, *Victoria Lead*, *Cumberland Lead*, *McFayden's Lead*, *Pewt's Hill Lead*, and what is known as the *Wet Ground* were examined. The Wet Ground has recently attracted attention, and an endeavour is being made to overcome the large body of water always to be contended with in prospecting it.

The other leads mentioned support a number of miners, but very little work is being done at the present time compared to the operations of a couple of years ago. Should the prospectors succeed in overcoming the water in the wet ground, however, and get down to payable washdirt, there will be renewed energy on this part of the field, as a lot of untried but wet ground is ready to be opened up.

The All Nations Claim on the Victoria Lead has been abandoned, but both energy and capital must ultimately be forthcoming to prospect this end of the lead as it possesses so many favourable features.

McFayden's Lead was discovered a few years ago, and at one time a large number of miners were employed on it. Mr. McFayden, it seems, was almost against his will induced to try the locality where he discovered the lead which bears his name, and his party's prospecting shaft was sunk on about the richest part of it. The other leads were opened many years ago, and since then, although some desultory work has been carried on, no remarkable results have accrued.

In 1894 Dr. Jack made an inspection of The Springs Leads. He states (*l.c.*: page 11):—

"In Cement Hill at the back of the Springs Hotel, a tunnel (Macgregor's) is driven beneath the cemented gravel which dips to the west, as does also the underlying silty sandstone locally known as 'the dig.' This silt bed formerly yielded *Glossopteris*, for which, however, I searched in vain. The cement is a close mixture of pebbles of quartz, schist, &c. There are no pebbles of granite or basalt.

"In Knust's Tunnel, south-south-west of the hotel, the cement lies partly on decomposed slate and partly on what is known locally as 'tish.' The latter varies from a coarse grit or fine conglomerate to a coarse hard conglomerate of large quartz pebbles. The silt which elsewhere intervenes between the newer cement and the 'tish' is absent, but it is obvious that the cement is unconformably related to the underlying 'tish.'

"Gerrard's Shaft, twenty-eight feet deep (north of the tunnel first described), is in cemented gravel. A drive is carried to the north-west for thirty feet from the bottom of the shaft, the ground falling to the south-west. Here the bottom is the grey silt, which is pretty hard. I saw good prospects washed from the bottom of the cement.

"Miller's Shaft, about a chain south-west of Gerrard's, is forty-five feet deep. A drive has been carried from the bottom of the shaft for sixty feet E. 20 degrees N., and the end of the drive has been connected with the end of a drive from Gerrard's Shaft. The bottom (shales) dips pretty steeply to the south. The gold, however, does not go down with the dip, but goes into the 'headings,' where the bottom dips down below the level of the drift. Miller's Shaft is on rather higher ground than Gerrard's, but the bottom dips from Gerrard's Shaft towards Miller's.

"Craven's Shaft is about 100 feet east-north-east of Miller's, and on the same level. The bottom of the cement is, however, fifty-five feet deep.

"The White Hill is separated from Cement Hill by a gully, but the two hills have obviously been continuous. The deepest shaft bottomed on the White Hill was ninety feet. Here the washdirt rested directly on a 'bottom' of slate or schist.

"Linklater's Lead runs uphill to the north-north-west, and the gold is obtained from cement lying on a bottom of 'tish.' The lead is narrow but rich, and was traced from shaft to shaft more than twenty years ago to near the south end of the Victoria Lead.

"The Victoria Lead lies in a gutter between the 'tish' on the east side and a slate blottom on the west as far as the top of the hill, where it commences to run to the north-east (downhill) with a fall of 1 in 8. The slate bottom is described as having had a pitch 'as steep as a roof.' On reaching the flat the lead turns to the north-north-west (at the whipshaft). From this point, for eighty or ninety feet, the lead contained very good gold.

"In the centre of Lease No. 56 a shaft has been sunk. At the west end of the shaft the 'tish,' which is treated as 'bottom,' is at the depth of sixty feet, and at the east end at the depth of ninety feet. The wash gave at the rate of about thirty-six ounces per load, a total of about £500 to £600 worth of gold.

"About 100 feet to north-north-west is the Windlass Shaft, just within the south boundary of Lease 51. In this shaft forty feet of basalt was succeeded by seven feet of clay or sand, and about 100 feet of gravelly drift. The water was, however, too heavy, and could not be got under by the employment of ten men, so that the prolongation of the Victoria Lead in this direction has yet to be proved. Here the surface is a good deal lower than that of the gravelly hill to the south.

"The All Nations Shaft, 130 feet north-north-west of the Windlass Shaft, was also a failure. It is said to have struck a 'bar.' The water was very heavy.

"Pewt's Hill rises from the basaltic flat. There is a slate bottom on the eastern side which deepens uphill; that is to say, the level of the surface of the slate falls to the west, while the surface of the gravel rises. The westmost shaft, eighty feet deep, had payable gold on the slate bottom.

"On the western side basalt is seen lapping round the Cement Hill. The slate is seen in a gully. Uphill, to the east, the bottom dips eastward more than the hill rises."

To the south of The Springs, on Apsley Creek, at the place known as the "White Gates," some surface gold has been found, and recently a number of men have been working in the locality. The gold is all in rough grains, although the wash in which it is contained is well waterworn, and probably has been shed from some leaders in the vicinity.

The Black Ridge Leads.

The situation of the Black Ridge is about two miles westerly from The Springs and about twelve miles N.N.W. from Clermont (see Map 1). This locality was worked in 1892, but it only became an important mining centre in 1894, when Mr. Applin made some discoveries which attracted the miners to the place. *Daintree's Gully, Hard Hill, Fox's Lead,* "*White Ground,*" "*Yellow Ground,*" are localities which have been prospected and to some extent worked.

In Daintree's Gully the sinking at one part of the lead is through a hard bed of "billy" sixteen feet thick, and, although the thickness of the rock is generally smaller than this, twenty-six feet of it was penetrated in one of the shafts before the lead could be bottomed. The "billy" is generally considered not to be gold-bearing, but the miners in the locality have a record of a seven-grain speck of gold being found in it at a depth of forty feet from the surface.

A ferruginous cement is sometimes found below the "billy," and also a fine sand occasionally. Boulders of quartz-porphyry and granite occur in the wash, and sometimes the whole of the material of the wash is cemented together with secondary iron pyrites, masses of which are met with in some of the workings. The character of this mundic accumulation in the lead indicates, undoubtedly, it to be a recent formation, and gold being present in it distinct from the gold in the wash itself, shows that the water percolating through the lead has precipitated this gold as well as the iron sulphide.

At the Black Ridge a large area of ground is ready to be prospected, and with a fair chance of success; but the great obstacle to development is the frequent occurrence of this bed of "billy."

The Miclere Leads.

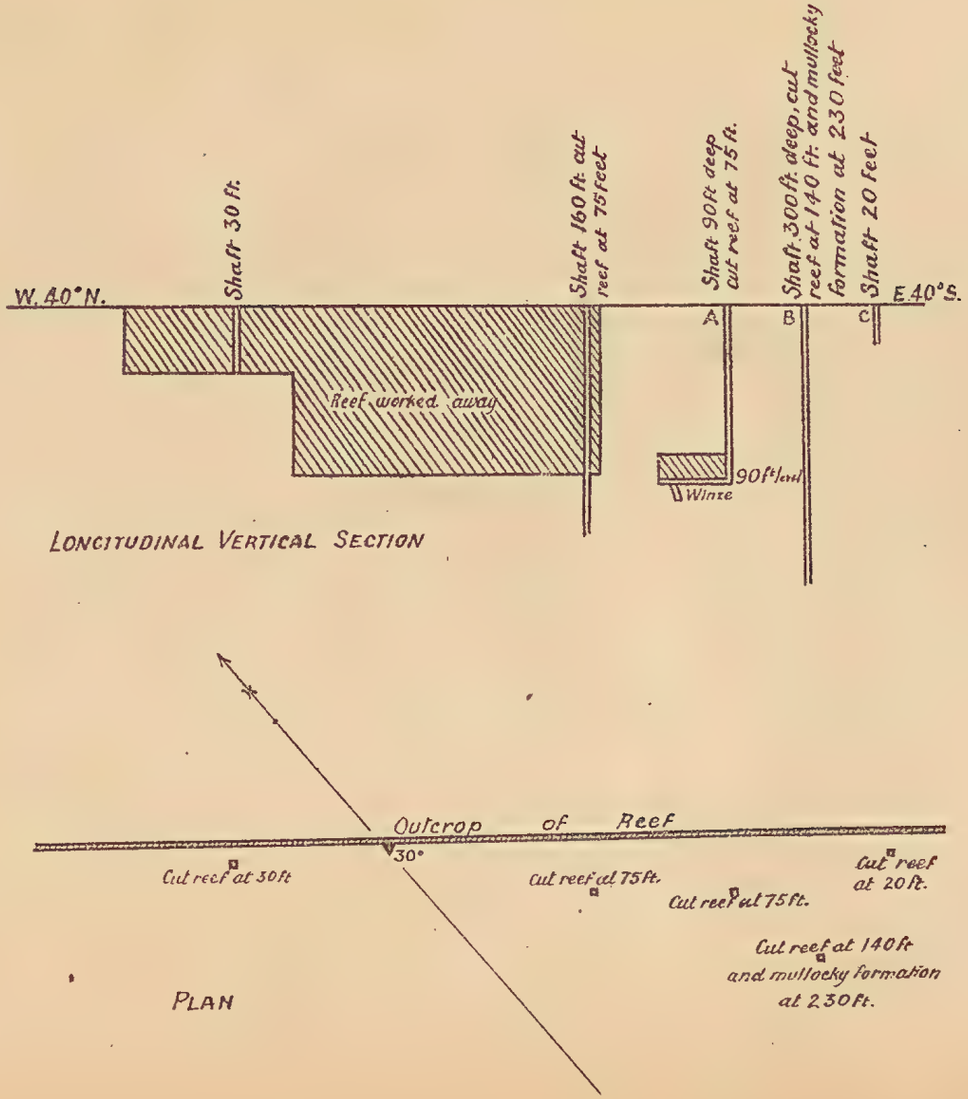
To quote Mr. Rands (*l.c.*: page 1):—

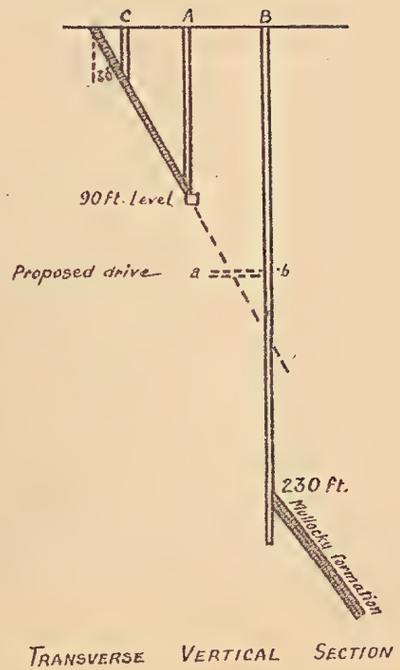
"These are situated about twenty miles a little to the west of north of Clermont, where an area of about six miles in an east and westerly direction by three miles in a north and southerly direction consists of schists forming an inlier rising through and surrounded by basalt country. The schists are micaceous, though in parts so arenaceous as to resemble micaceous sandstones. They dip to the south-west, and are very much crumpled.

"The Miclere Creek runs through this area in a westerly direction, and parallel with it, and on either side are two ridges. It is in the gullies running down from these ridges, and also in the main creek, that the alluvial workings have been carried on. These diggings were very rich when first opened up some years ago, and ever since a few men have been able to make a living on them. It would appear as though the gold must have come originally from these ridges, but as yet no reefs have been found, with the exception of one on the southern side of the Miclere Creek."

HOMEWARD BOUND REEF.

Scale . 30 Yards to 1 Inch


W. 40° N.
Shaft 30 ft.
Shaft 160 ft. cut reef at 75 feet
Shaft 90 ft deep cut reef at 75 ft.
Shaft 300 ft. deep. cut reef at 140 ft. and mullocky formation at 230 feet
Shaft 20 feet
E 40° S.
A
B
C
Reef worked away
90 ft level
Winze
LONGITUDINAL VERTICAL SECTION
Outcrop of Reef
30°
Cut reef at 30 ft
Cut reef at 75 ft.
Cut reef at 75 ft.
Cut reef at 20 ft.
Cut reef at 140 ft and mullocky formation at 230 ft.
PLAN



(Reproduced from Plan by Mr Rands)

GEOLOGICAL SURVEY OF QUEENSLAND

Plate I

Dr. Jack, in his Progress Report for 1896 (*l.c.*: page 12), refers to a number of the workings as follows:—

"In James Ferguson's Prospecting Area, about a mile from the left bank of Miclere Creek, a four-ounce nugget was found on the surface. The operations so far have been unimportant, consisting of trenching and sinking. There are a few feet of 'surface' containing blocks of basalt, quartz, and ironstone resting on a slate bottom.

"Swan's Surface working runs northward from a little tableland of hard conglomerate in which quartz and quartzite pebbles are embedded in a matrix of quartzite. Below this conglomerate is a rich auriferous drift. A little distance north of the edge of the conglomerate the slate bottom is touched in a shallow working in the gullies.

"Fullerton's Lead runs north-west and south-east between two of the gullies which fall into the left bank of Miclere Creek to the left of the south bank, and deepens to the north-west. The washdirt lies on a slate bottom, and contains good gold and numerous large boulders of a conglomerate such as is seen at the head of Swan's Surface.

"Walters' Surface is a drift of which parts were rich. The washdirt lay on a white clay drift, containing quartz pebbles, and was capped by a quartzite-conglomerate similar to that at Swan's Surface.

"In the Lower Camp workings the auriferous lead crosses Mills' Creek, and deepens to west-north-west.

"Morrison and Locke's Shaft is of importance, as it has passed, at the depth of twelve feet, through a good auriferous wash resting on 'tish' the top of which was regarded until recently as 'bottom,' and at the depth of thirty-eight feet the base of the 'tish,' consisting of very large close-packed boulders of slate quartzite, schist, and granite resting on slate, proved to be auriferous. The upper wash, originally worked, was about eighteen inches in thickness, and consisted chiefly of quartz gravel lying beneath a clayey alluvium. The washdirt at the bottom of the 'tish' averages three feet in thickness, and contains fewer pebbles or boulders of quartz and more of granite than does the upper wash. A few hundred yards to the north-east the slate appears at the surface in contact with the base of the 'tish.'

"In Tripp and Reid's Shaft, twenty-seven feet in depth, there is about two feet of washdirt at the base of a 'tish' similar to that in Morrison and Locke's. There was another layer of payable washdirt twelve feet above. A second shaft with which the present shaft is connected gives a similar section. The upper wash in both shafts consisted chiefly of quartz gravel, and rested on the 'tish' which was assumed to be the bottom.

"In Smith and Yorke's Claim there are two shafts. In the old shaft the first auriferous wash is within four feet of the base of the 'tish' which rests on a slate bottom. In the new shaft there are eleven feet of 'tish' between the two drifts. The lower drift contains good gold.

"In Lewis's Shaft, which is thirty-five feet in depth, a false bottom, or top of the 'tish,' was met with at eighteen feet. The wash at the base of the 'tish' deepens to the south-west—*i.e.*, towards the outer edge of the alluvial flat on the left bank of Mills' Creek. The last shaft in this direction has been sunk to a depth of forty feet without bottoming. About twenty feet up the rise, on the edge of the alluvial terrace, is another patch (Boulder Gully) of quartzite conglomerate of the same type as that in Walter's Claim, but being rather more of quartzite and less of a conglomerate. There is a wash about the big stones and between them, but it is said not to be so good as at Walters's."

Of late years the Miclere has not progressed very much in mining development, and would very probably be an abandoned field were it not for the introduction of machines for saving gold without the use of water. By the aid of dry-blowers and other machines, the surface soils on the ridges which would not pay to cart to water and some old tailings are being worked, and this keeps a number of men employed. Reference will be made to the dry-blowers further on.

A sample of gold, adhering to a partly waterworn piece of stone, was obtained by Mr. Barker from the formation called "tish" in one of the shafts at the Miclere, and a subsequent examination of this showed that the gold had been deposited on it since it became waterworn, from which it may be concluded that, at least, some of the gold in this "tish" has been deposited *in situ*, and therefore subsequent to the formation of this as a sedimentary deposit.

Wherever the tish has been tried it has been found to be auriferous, although very seldom has it proved payable. It extends from the Miclere towards the south, and is found at Johnstone's Camp, McMaster's Camp, Blair Athol, and Hurley's Diggings, and also at The Springs and Leo's Flat.

The presence of coal in the tish has also been noticed by the miners, and a seam of coal was penetrated in one of the shafts after passing through eighty feet of tish. Below the coal there is a bottom of carbonaceous shale, and under this a sandstone.

At Boulder Hill on the Miclere the billy occurs as a well-defined bed of about three feet thick and covers a lead which at one time was extensively worked. The gold occurs immediately below the billy, and there is every appearance of the billy, as a bed of sandstone or conglomerate, being formed over the lead and subsequently becoming altered to quartzite, its present form. The billy at Boulder Hill contains gold, but instances of finding the gold in it are not common.

The billy occurs about one mile south-west from the "lower camp" at the Miclere, and thence extends southerly without a break to the Black Ridge.

Frequently the gold is associated with ironstone, as pointed out by Mr. Rands; but, where the ironstone is expected to be found, sometimes a "clinker"—dolomitic limestone—occurs instead.

Although there is so little shaft-sinking being undertaken at the present time on the Miclere, some of the ground appears to be favourable for prospecting purposes. The trouble in development, however, is the large area of old ground which requires draining before the new ground can be opened, and, as the old and new ground form the bed of the creek or gully, draining this area would be carried on constantly under difficulties.

The age of the old leads here is probably Permo-Carboniferous, as the fossil fern *Glossopteris* has been found in layers of fine sediment in the tish three miles north of the Miclere, associated with similar formations.

Leads South of the Miclere.

Seventeen-mile Well.—Dr. Jack states in his Report (*l.c.*: pp. 12-13) with regard to the deposits in this part of the district, that:—

"The Seventeen-mile Well is on the head of one of the southmost tributaries of Miclere Creek, on the road from The Springs to the Suttor. Six feet of black soil lay on sixty-nine feet of basalt, the bottom of which was not reached. There are seven feet of water in the well. A little north of the well a pebbly quartz like that of Swan's Surface overlies a gravelly wash which rests on a white, sandy clay. 'Colours' of gold can be obtained around this quartzite.

"On the road from The Springs to Miclere (which is parallel with the road from The Springs to the Suttor), about three miles east of the Seventeen-mile Well is another well (*a*) which gives a section of:—Surface, twenty feet; basalt, twenty feet; soft red clay, 100 feet.

"The water stands about sixty feet from the surface. A specimen of the red clay shown to me seemed likely enough to have resulted from the decomposition of a basalt.

"A second well (*b*), one mile further to the east, gave the following section:—Basalt, forty feet; layer of mundic, (?); decomposed basalt, (?) fifty-six feet.

* * * * * * * *

"It is evident from these two wells that the basalt under which the All Nations Lead disappears thickens considerably to the north-west. As, however, the bottom of the basalt at well (*a*) must be considerably beneath the level of the edge of the basalt where it overlies the quartzite ridges at the head of one of the branches of Miclere Creek, it is probable that the basalt, and therefore possibly the lead, occupies a trough in the older rock in some other direction, possibly running north or north-east."

All the workings are now abandoned.

Johnstone's Camp (*l.c.*: page 13):—

"Another small tableland of quartzite, rather more pebbly than that at the Seventeen-mile Well, lies about a quarter of a mile W. 15 degrees S., and good colours of gold are met with all round. About 100 yards W. 10 degrees N. of the last-mentioned quartzite are the workings known as Black Johnstone's (Harry Johnstone). Here at first there was only, as it were, a sprinkling of wash, which was, however, rich on the slate bottom. The depth of the wash increases to the north down to the creek, on the left bank of which the sinking is from fifteen to sixteen feet.

"Bill Pearce's Shaft strikes a soft slate bottom at the depth of thirteen feet. There is a sandy and clayey drift from the surface down to two feet from the bottom, where it is more gravelly."

The tish occurs in deep ground in this locality, but has not been bottomed. The claims are now all abandoned.

McMaster's Camp.—This part of the field is almost abandoned, only an occasional miner being seen at the present time. Dr. Jack states (*l.c.*: page 13) that:—

"At McMaster's (Bennett and Holloway's) Shaft, which is thirteen feet deep, a micaceous and schistose slate forms a very irregular bottom for the auriferous drift. This bottom deepens uphill (to the south-east). There are several layers of clay in the sinking. A gravelly wash of two feet rests on the slate, and it is said that this wash yields best when it is, so to speak, 'plastered' into gutters. About fifty feet east-south-east of McMaster's a shaft strikes the slate at twelve feet. On this there are eight inches of auriferous washdirt beneath a three-inch bed of slate or 'sandstone,' which deepens towards the hill (south-east). Above this there is a cemented wash, which, however, is poor. In another shaft to east-north-east, at the depth of eight feet, there is a false bottom of clayey sandstone, resting on the top of the 'tish.' The bottom of the 'tish' is met with at the depth of thirty feet, resting on slate. Both the false and true bottoms dip towards the hill.

"One hundred feet to the south-east another shaft has been sunk to the depth of fifty-three feet, where it touches a sandstone eight feet in thickness. The first gold is obtained in the bottom of the 'cement,' resting on a 'sediment.' This 'sediment' is met with in several deeper shafts, where it rests on an older wash. Gold is traced from this spot in shallow workings up to and across the divide between this and another gully."

Billy occurs on the surface here, and tish and cement in the deep ground. The gold is usually coated with oxide of iron, and frequently quite black, and not very easy to detect. Its specific gravity, however, betrays its presence to the miner.

Yankee Camp (*l.c.*: page 13):—

"Yankee Flat is situated on the head of an affluent of Miclere Creek, close to the divide between these waters and the heads of Bath Creek. Roper Brothers' Claim has a shaft about eighteen feet deep. The drift is seen from ten to eighteen feet deep in the shaft. The bottom is slate, containing leaders of quartz. A white quartz-wash lies on a bottom of a soft 'sediment,' partly of siliceous and partly felspathic material, dipping at 15 degrees.

"The reef is seen in the slate in McCarthy and Bell's Claim. Good gold is seen in the rubble derived from this reef on the bottom wash. There are well-rounded pebbles and boulders of quartz and quartzite in the wash above, and obviously derived from another source.

"From the bottom of Luke Benstead's Shaft a slate bottom dips at a rather steep angle, and is covered with a washdirt containing good gold until the bottom rises again. In a hollow lying between this bulge and the outcrop of a reef which rises above the general level of the slate, there is fair gold in a rubble, evidently derived from the reef. The bottom is a decomposed sandy slate."

Leads at Seven-Mile and Brigalow Creek.

Seven-mile Diggings, Nuggety Gully Lead, Specimen Gully Lead, Decima Lead, Scotchman's Lead.—These leads are all situated on the Drummond Range from about ten to twelve miles west of The Springs (see Map 1), but they only support a few miners at the present time. Each have yielded rich patches of wash, but now all are practically worked out.

The country is of slate formation—micaceous, talcose, and quartzose, and in parts very ferruginous—and compared to other localities in the Clermont District, in which reefs have been worked, looks very favourable for the occurrence of gold-bearing reefs.

At Specimen Gully some of the gold found in the leads was attached to quartz, and Mr. Rands when examining this stated that—"This gold could not have travelled far from its source, and there can be no doubt that it, as well as that in the gullies at the Seven-mile, came originally from reefs situated in the Main Range."

Hurley's Diggings and Neighbourhood.

Two-mile Gully.—Mr. Rands, referring to this locality, states (*l.c.*: page 2) that:—

"Old workings exist all the way between the Seven-mile and Two-mile Diggings, which lie to the south. The country consists of grey slates and micaceous schists dipping to the south-south-west. The washdirt in the gullies here consists of a quartzose gravel and sand with pebbles of ironstone; gold is most plentiful where there is much ironstone."

Hurley's Diggings, Hurley's Cement Lead, Hurley's Deep Lead.—At Hurley's Diggings there is always some gold to be obtained by "fossicking" about, and so a few miners are always to be seen in the locality. The Cement Lead mostly occupies the caps of ridges, and only in a few places is it exposed in the gullies. The hard cement or conglomerate of which it is formed dips at an angle of about 30 degrees, and, although the outcrop has been well worked over, very little has been done below the surface on account of the difficulty in working the deposit. Boulders, tons in weight, occur in it most irregularly, and consist of quartz, quartzite, sandstone, and slate, some of which bear a striking resemblance to the sandstones and quartzites of the "Star" Beds of the Drummond Range to the south-west.

From the confusion in which the deposits of small and large boulders are packed in the Cement Lead, it would seem that they have formed at the bottom of a declivity, and the gold in occurring irregularly on ledges of the steeply-inclined floor further suggests that no alteration in the position of the floor of the cement or conglomerate has occurred since the gold was deposited.

It has not been ascertained to what depth the conglomerate extends. When the underground workings opened up the deposit along the steeply-inclined floor, it was thought that a bottom of an old ravine would be found, but the incline is persistent and no bottom to it has yet been met with, and so only one side of the deposit is known.

Tests have been made of the conglomerate to ascertain whether battery treatment and amalgamation would be successful, but so far the results have not been sufficiently satisfactory to continue the work. The amount of stone available which is said to carry a few pennyweights of gold is enormous, and possibly other methods of treatment might meet with more success.

The gold in Hurley's Deep Lead evidently has its source in these auriferous cements, as the lead heads where a body of this has been worn away.

The Venus Leads.

Hurley's Wet Lead, Rip-and-Tare Lead, Blacksmith's Gully, Venus Lead.—These are all within a couple of miles to the north of the Venus Hotel (see Map 1), near the junction of Bathampton and Hurley's Creeks. The Venus Lead has recently been opened, and a large amount of prospecting has already been carried on, but without much gold being found in it. The gold occurs irregularly in the wash, and the wash itself is very patchy.

Hurley's Wet Lead on Hurley's Flat (or creek) just north of the Venus Reef has workings, old and new, almost all the way up to Hurley's Diggings, which are at the head of this creek. The sinking is gravelly, and the wash occurs at a varying depth to thirty feet or more. The water is mineralised.

Native Bee Diggings.

These old workings have long since been abandoned, and the ground has been taken up as a selection. To the west towards the Drummond Range the watercourses have yielded gold, but very little has been done in working them during recent years.

Leads Around Fiddler's Creek.

Boozer's Lead, St. Patrick's Lead, True Blue Lead, Shearers' Gully, Chinaman's Gully Lead:—All of these leads are close to the junction of Sandy Creek and Fiddler's (or Bathampton) Creek, but with the exception of Fiddler's Creek Lead very little work is being done on them at the present time. Fiddler's Creek Lead has had a considerable amount of attention directed to it from prospectors, and a large quantity of gold has been taken out of some of the claims, more particularly those near the crown of the ridge which divides it into eastern and western branches (see Map 1).

Fiddler's Creek Lead was worked and abandoned some years ago, but about the end of 1900 a miner named John Naumann, with a dry blower, traced a poor wash to a rich one on the crown of the ridge. Another miner named Hutchens had an idea that the gold would be found deeper, and in prospecting the lead this was found to be true, the lead developing into a very rich one, hundreds of ounces being obtained from some of the claims. The wash is composed of angular fragments of quartz, very little waterworn, with a stiff reddish or yellowish clay, and rests on a decomposed slate bottom. The bottom near the crown of the ridge is most irregular in shape, altering in width most abruptly from a few feet to several yards, forming pot-holes and bars and ledges every few feet, and evidently formed by the action of a small but rapid torrent of water.

At one spot on the lead a trial shaft had been sunk, but on finding a slate bottom was abandoned. In the opening up of the lead subsequently the wash was traced under this trial shaft, and the slate in it proved to be a false bottom of "floating" slate, as the miners term it, which had accumulated over the rich wash by sliding down bodily from the sides of the channel.

Boozer's Lead is on the south side of Fiddler's Creek, and opposite Taylor's Creek junction. It was opened in November, 1900, and was proved to a length of 400 feet, although prospected for a quarter of a mile. The sinking was about twenty feet, and the wash was a few inches thick with the gold at the bottom of it resting on a decomposed slate. The gold was "shotty," sometimes in half-ounce pieces, but the yield generally was poor.

St. Patrick's Lead has a few men working on it, but the wash is not rich. The other leads mentioned above have been abandoned.

Leo's Flat Lead.

Leo's Flat is situated to the north-east of Clermont, and is drained by a branch of Wolfang Creek. The lead is similar to Hurley's Cement Lead in the occurrence of cement, in the character of the pebbles and boulders composing it, its steep angle of dip, and other features. The lead has been traced some distance along the outcrop, but with its steeply-inclined floor dipping towards the north-east, the deposit becomes very deep, and there is no indication of its rising again to the surface.

The wash near the surface was very rich and not covered by conglomerate or cement, but in the deep ground a deposit of this rock occurs above it. In deeper ground the conglomerate has been sunk on to a depth of 180 feet without obtaining the bottom wash. In all this deep ground gold can be found, but not in payable quantities. The boulders in the conglomerate are frequently a couple of feet in diameter, and comprise quartz-porphyry, mica-granite, quartzite (not "billy"), chlorite schist, and quartz schist, some of which are found in Hurley's Cement Lead. The quartzite and granite particularly are similar to that found in the latter lead, and also to that in the Bower Bird Lead on the south side of Clermont.

Black Snake Lead and Two-Mile Creek.

The Black Snake Lead is about two miles to the north-west of Clermont, and was opened in 1899. A large amount of work has been expended on it, and although some parts of it yielded four and five pennyweights of gold to the load, it did not prove to be a rich lead. The sinking was from sixty to eighty feet, wash and "headings" eight to ten feet, and a bottom of white decomposed slate. The gold was fine.

At the Two-mile Creek some surface deposits have been worked. They consist of gravelly quartz and ironstone without clay, some parts being rich but very irregular, one miner getting, perhaps, half-an-ounce of gold in one prospect and no more for several days.

Expedition Leads.

These leads are situated nineteen miles west of Clermont, but were not examined. There are about half-a-dozen leads, of which the main one is about half-a-mile wide and two and a-half miles long, and, although they have been almost deserted for many years, there are miners on the Clermont field at present who are of opinion that the Expedition Leads still offer inducements for further prospecting work.

There was a large population of Chinamen on the Expedition before the great Palmer "rush," and Mr. Young, of Clermont, stated that 4,000 Chinamen must have been working on it before an exodus to the Palmer Gold Field took place.

Oaky Creek.

Oaky Creek is a branch of Sandy Creek, having its source in the Drummond Range to the west of Clermont. Gold has been found in numerous localities in the creek and in the watercourse leading into the creek, and large areas in the channel at the lower end have recently attracted attention from a gold-dredging point of view. Should the present dredging operations in Sandy Creek prove successful, there is no doubt the alluvium in this creek will also be worked.

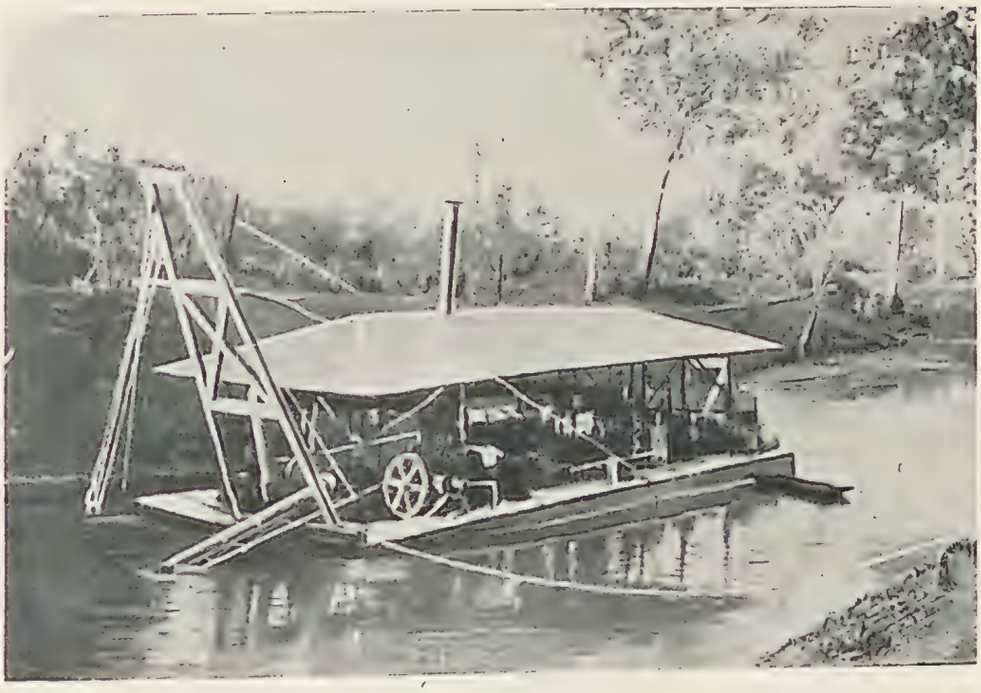
Sandy Creek Leads.

At the head of Sandy Creek some gold has been found in the gullies there, and also where the creek trends through the Native Bee Diggings. Oaky Creek referred to above also junctions with it; and Taylor's Creek, draining auriferous country around Fiddler's Creek, and Apsley and Gowrie Creeks, two branches of Wolfang Creek where a considerable amount of gold has been found at different times, all drain into Sandy Creek. Besides these feeders, a number of leads and gullies close to Clermont, which have yielded a lot of gold, fall direct into Sandy Creek.

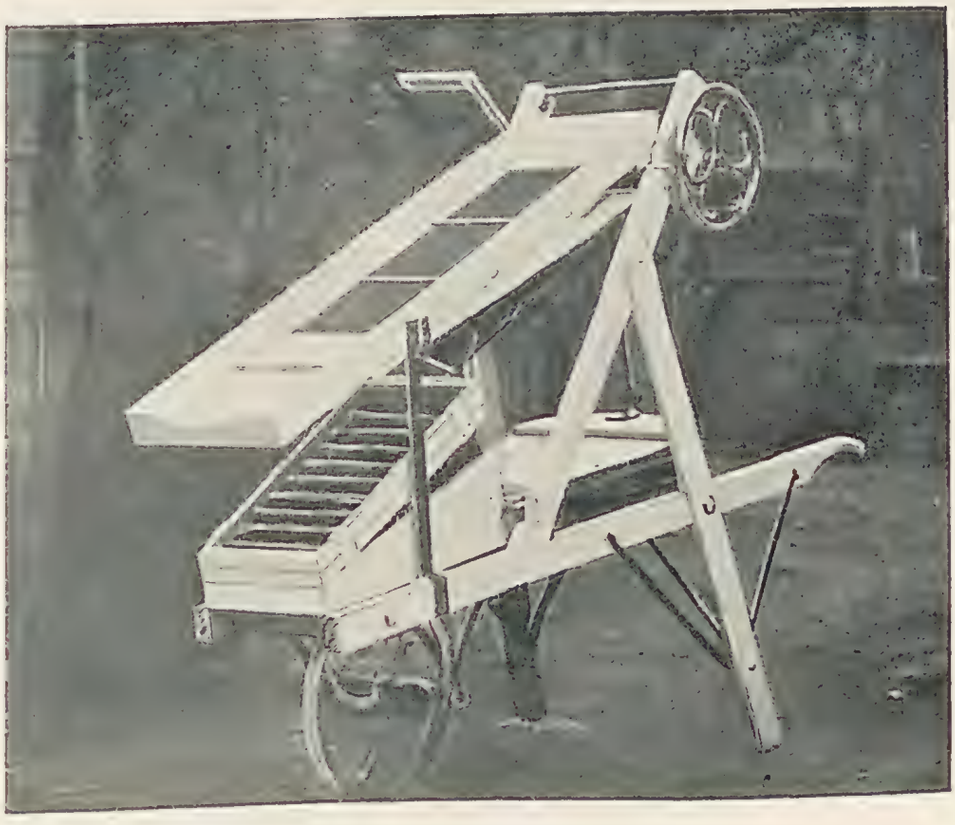
All the above factors have been considered in selecting the bed of Sandy Creek, near the town of Clermont, as a promising spot for dredging operations. *Golden Hill*, *Baker's Hill*, and *Norwegian Gully* are close to the northern bank of Sandy Creek, opposite the cemetery, and a few miners are working about them at present. Most of the old workings, however, are abandoned.

The Goat Lead is situated about half-a-mile to the west of Clermont, close to the northern bank of Sandy Creek, but is now abandoned. The wash is conspicuous from the amount of ironstone pebbles in it, and which have been derived from an ironstone formation close to it. The presence of too much water prevented the gold being traced into the deep ground.

At Poverty Point there is another small lead, being a branch of the Goat Lead which it resembles.



Clermont Gold Dredge.



The "Knocker" Dry-blower.

Quarry Hill Shaft.

This shaft was sunk to test the sedimentary rocks below the crown of Quarry Hill, a small eminence within half-a-mile of the town of Clermont. Dr. Jack, referring to the sinking of this shaft, states that:—

"The argument on which the shaft was sunk in search of a deep lead was that surface indications showed the strata to occupy a very narrow area and presumably to fill up a valley, and that in the bottom of this valley a deep lead might—with luck—be found. The depth of the strata (and consequently of the valley, assuming this theory to be true) has proved to be beyond all expectations, and the 'valley' must have something of the contour of a canon. One thing is now certain, that whatever the surface strata may have been, those now met with near the bottom of the shaft are marine, for the fossils are of strictly marine types (well known in the 'Middle or Marine' Series of the Bowen River Coal Field). This fact, however, is no argument against the possibility of the marine strata covering an old river drift; and as a drift in such a position, *i.e.*, occupying the lowest possible gutter in the slate 'bottom' of a district rich in alluvial gold, might prove even richer than the best in the district, many citizens who have spent their money on the venture are reluctant to give it up without a further effort to see it out. The appearance of large boulders of granite may be an indication that the bottom is near, but no man can predict its actual depth, and the attempt may end in further fruitless expenditure.

"I cannot, with any confidence, recommend further expenditure, for the scheme is an experiment after all, and was entered into without any idea that it would be necessary to sink to so great a depth. It must be remembered that the shaft may not 'bottom' on the actual trough of the valley, and that to miss it by a few feet would be as bad as to miss it by a mile. If, however, the townspeople are content to raise further capital to carry on the work, I think that a claim on their part for further assistance from the Government should be favourably considered."*

A later examination of the shaft was made in connection with the survey of the coalfields by the writer, and in the report thereon an illustration is given showing the strata passed through in sinking.

During the more recent examinations aneroid measurements were taken of the hill and surrounding country, and these are shown in contour on Map 2.

The reason why the shaft was sunk right on the crown of the hill on the cap of a hard knob of "billy" cannot be ascertained, but much of the work could have been avoided by putting down the shaft at a distance of 100 feet away from its present position lower down the side of the hill. By going still further down the hill at a distance of 300 feet, the shaft could have been commenced sixty feet lower down, and, apparently, there is no reason why the shaft should have been started on the top of the hill any more than further away at the base of it.

Judging from the surrounding country, the strata passed through in the shaft, and the absence of marine beds from all the gold leads in the Clermont District, the best course, no doubt, was that suggested by Dr. Jack—not to incur any further expense in sinking. At the same time it must not be forgotten that the Permo-Carboniferous marine beds undoubtedly rest on the upturned edges of a formation which carry innumerable quartz veins, and there is a possibility that the marine beds have overwhelmed an older sedimentary gold-bearing formation in the same way that the freshwater beds of the same age—the coal measures—have covered old gold leads in other parts of the district. Even in the Quarry Hill Shaft below the coal bands, colours of gold have been found in a "wash" at a depth of about 300 feet. Regarding the source of the granite boulders found in sinking the shaft, possibly they came from the south-east in the direction of the granite of Policeman Creek, or from the south-east in the direction of Capella. In either case the position of the granite is considerably higher than where the boulders were found in the Quarry Hill Shaft. Against this idea, however, there is the fact that granite occurs in the Leo's Flat and Bower Bird Leads at some hundreds of feet above the granite boulders in the Quarry Shaft. Again, the boulders from the shaft, associated with the granite, resemble those at Leo's Flat and Hurley's Cement Lead, and here there is evidence that the débris once travelled over beds of "Star" formation, which are not to be found closer than the Drummond Range. We may add to the difficulty in solving the question the possibility of faulting or other alterations in the level of the Permo-Carboniferous strata since they were deposited. Nevertheless, the opinion is expressed that the granite boulders of Quarry Hill Shaft and the other places came from the south of Clermont, and had their source in the granite masses exposed about Policeman's Creek and towards Capella.

Wild Cat, Kitten, and Bower Bird Leads.

These leads are situated a short distance to the south of Clermont, and have a direct connection with one another. The Wild Cat Lead from its source trends northerly to join, first the Kitten Lead coming in from the south-east, and next the Bower Bird Lead from the west. From its junction with the latter lead its course is easterly.

Dr. Jack, who made an inspection of the Wild Cat Lead in 1897, states in his Report (*l.c.*: page 11) that:—

"The leads commenced to the north-west with shallow sinking, and have deepened to about eighty feet at the point indicated by the sketch. Here are Brewer's or 'The Dynamiters' (eighty feet deep), from which four men raised in five weeks 115 loads, which gave eighty-six ounces; and O'Brien and Knight's (eighty feet deep) from which sixty loads of wash gave 390 ounces. On descending O'Brien and Knight's shaft, I found that they were taking out about two feet of wash, full of immense boulders of quartz. This is by no means the total thickness of the 'gravel,' but it is understood to be poorer as it gets up from the bottom. 'The Dynamiters' took out eighteen inches of wash. In both claims the quartz boulders are large (from three cubic feet downwards), which would lead to the inference that they had not travelled far, and fairly well rounded, from which the contrary inference might be drawn. The quartz of the boulders is admitted to be almost barren, so that the gold may be taken to have come from some other source. On a former visit I came to the conclusion that the alluvial gold of the district had

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Annual Progress Report of the Geological Survey, 1896-8. By Auth. Bris. 1899. G.S.Q. 143, page 11.

been derived not so much from the known reefs, but from the weathering of the innumerable lenticular veinlets of quartz which occupy the bedding, joint, and cleavage planes of the slates and schists. The quartz boulders are not sent to the puddlers, but are carefully cleaned from adherent auriferous wash, so that the amount raised is greatly in excess of the amount washed. Carting and puddling cost 5s. per load. Each horse gets through twelve loads per day.

"The whole area is 'made ground,' and nearly flat, so that until at least the shafts which are on gold are located it is almost hopeless to trace the course of the various leads. There are said to be (and I can quite believe it) some thousands of shafts, and some are bottomed on gold and some are not. The Prospecting Association's shaft is about a mile and a-half south-east of the Wild Cat group and about half-a-mile from the nearest shaft on payable gold. It has bottomed at 148 feet on a wash of the usual character, and drives are being made in search of payable gold. It may be regarded as proved that the bottom deepens to the south-east, and even at the Prospecting Association's shaft it is already far below the level of Sandy Creek, so that it is obvious that the leads do not belong to the present river system. From anything which can be seen, the whole area between Deep Creek and Sandy Creek is just as likely to contain payable leads as the localities where they are at present known, but they are not likely to be discovered without many failures.

"I have made arrangements for an accurate survey of the workings."

During the recent examination traverses were made to fix the position of these and other leads, and the information obtained fully bears out a recommendation made by Dr. Jack some time ago that a feature survey of these leads should be made.

A very great number of shafts have been sunk on the leads, but the information concerning them cannot be obtained, as they are all abandoned.

The lower portion of the Wild Cat Lead, it is said, contains acres of wash not touched which average five pennyweights of gold to the load, but the depth only amounts to a few inches, and the wash is very hard to take out.

The "deep wet shaft" on the Wild Cat Lead was sunk to a depth of 180 feet, but the influx of water prevented the wash from being taken out. Close to this shaft another one was sunk 200 feet deep, and bottomed on slate without water being met with. It was intended in sinking this latter shaft to drive into the slate at the bottom, and tap the water in the wet shaft when all pumping arrangements were completed, but unfortunately the water came in rather unexpectedly and swamped the shaft and the pump in it. Since then no work has been done, not even to remove the pump.

The deep wet shaft and others which have been sunk in its vicinity show that the water is confined to a narrow stream, some shafts getting abundance of water while others are almost dry.

Half-a-mile further up the lead near O'Brien's shaft—westerly from the deep wet shaft—a slate bar crosses the lead and forms a "jump-up" from the east to the west of about twenty-six feet, and, while the eastern or lower side was not very rich, in O'Brien's shaft on the west side of the bar some very rich "wash" was taken out.

Further west there is a slight undulation on the surface above the lead, and from a consideration of this, and also of the depths at which the "wash" has been obtained in the shafts, it is found that only a very slight rise takes place from the bar to the junction of this and the Bower Bird Leads. At the junction the sinking is eighty feet, and at O'Brien's shaft 112 feet, and the difference, thirty-two feet, represents the amount of fall between the bar and the junction, a distance of three-quarters of a mile.

A peculiarity has been noticed by the miners who have been working on the Wild Cat Lead regarding the rich and poor parts of the lead. They found that the lead was invariably poor where it was crossed by a watercourse on the surface, while the fifty feet or more of sediment resting on the lead was admittedly impervious to the water above. No connection, however, can be established between the two facts.

Another feature has been pointed out by the miners. This is the presence in some of the leads of what are called "pilot stones." They have proved useful to the miner in looking for the gold, and equally so to the writer in clearing up some doubts regarding the relation of some of the leads to one another. The "pilot stones" consist of a fine-grained quartzite of almost crypto-crystalline texture, very smoothly waterworn, and generally coated wholly or in part with a black film. They have been found with the gold in the wash, and, when the miners are "off the gold" and are not certain they are prospecting in the right direction, the presence of an occasional pilot stone is reassuring. Regarding their origin, they cannot be compared to any of the rocks around Clermont, but closely resemble, although not identical with, the quartzite pebbles of Hurley's Cement. Specimens of the stones have been obtained for future reference.

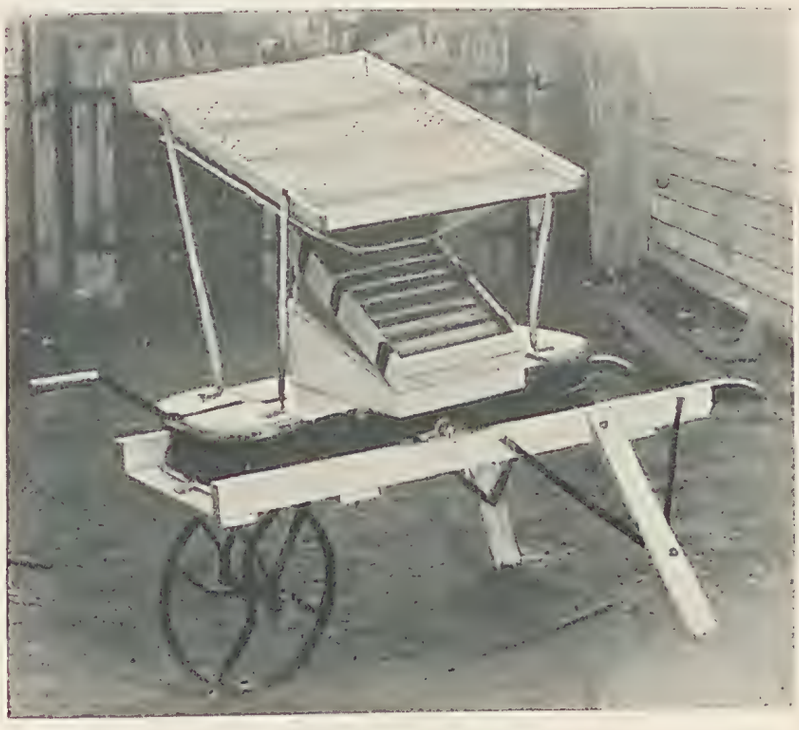
The Wild Cat Lead has no pilot-stones in the wash in its southern branch above the junction with the Bower Bird Lead, although below the junction and in the Bower Bird they are present.

In the very rich parts of the wash in the Wild Cat Lead some boulders were found to be incrusted with manganese dioxide, and Mr. Hopkins, an experienced Clermont miner, states that the wash has been exceedingly rich where these incrustations have been found on the stones.

Fragments of a fine white sandstone, and pieces of quartz from reefs or leaders, are to be found in the Bower Bird Lead, and in the Wild Cat Lead only below the junction, which, taken in conjunction with the presence of the "pilot-stones," suggests that the main lead has its source at the Bower Bird to the west, and not at that portion of the lead coming from the south.

The Bower Bird Lead further west again is different from the Dead Horse Lead, although they are close together, while the heads of the latter lead and the Wild Cat Lead, both almost parallel to one another, are similar.

The Kitten Lead has none of the white fireclay so conspicuous and so abundant in the Wild Cat Lead, the formations being gravel, with more or less ironstone and cement, and from which clay or



Carlson Dry-blower.

Rankine Dry-blower.

"pug" is absent. On the other hand, the bottom of the Wild Cat Lead below the junction of the Bower Bird is a fine sandy shale and sandstone with quartz veins, and the bed rock above the junction and along the Kitten Lead is slate.

The wash was very rich near the head of the Kitten Lead, some of it yielding twelve ounces to the load, but it pinched out very suddenly, and, although acres have been prospected at the head to find a continuation of it, so far the work has been without success.

The Bower Bird Lead above the junction widens out to about 200 feet, but gradually narrows towards the head near the Dead Horse Lead. From the latter it is separated by a "wash-out," and which has been filled in again by a more recent deposit of gravel and pebbles of basalt known as the "Basalt Wash." The wash-out by the basalt drift has not been complete in some places, and some of the workings show the "Basalt Wash" resting partly on the Bower Bird wash and partly on the slates forming the bottom of this lead and the Dead Horse Lead.

Leads at the Head of the Wild Cat Lead.

Federation Lead.—This is a surface trail of ironstone wash running closely parallel to the upper end of the Wild Cat Lead. Most of the wash raised have yielded four or five pennyweights of gold to the load. The bottom below the wash of this lead and also of the head of the Wild Cat Lead is slate, and outcrops of this rock on the surface show it to be chloritic and to contain small crystals of magnetite.

Busy Bee Lead.—The position of this lead is about half-way between the head of the Wild Cat Lead and the Clermont-McDonald's Flat Road, and on the watercourse known as the Busy Bee Gully. The workings are not extensive, the wash being close to the surface, but the yields were moderately rich.

Maggot Lead.—Another small deposit in the Busy Bee Gully is known by this name, and is situated about a quarter of a mile above the Busy Bee Lead. The wash is irregularly distributed, but several patches giving good yields of gold have been found on it.

Palm Tree Surface.—This lead is at the extreme head of the Busy Bee Gully, and the gold was found right on the surface. No particular trail of wash could be observed, the workings being scattered all over the surface. Being shallow, the wash has been worked repeatedly by miners with dry-blowers and dry-jiggers—a practice very common on such leads around Clermont.

Dead Horse and other Adjoining Leads.

Dead Horse Lead.—This lead has a north-east course heading near a belt of ferruginous quartzite, and abruptly ending at a bar of green chrome-bearing quartzite near the Clermont Railway Reserve. Near its north-eastern extremity it is disconnected by the "Basalt Wash" for about 100 yards.

The northern end of the lead near the wash-out is irregular, but on the other side of this the lead becomes permanent, and rises south-south-westerly for about half-a-mile. Here it takes a sudden turn more directly south-west towards the Ironstone Gully, where an ironstone wash of more recent formation cuts across the top end of it.

The bottom of the lead is a talcose slate, and the wash consists of gravelly and whitish fireclay, and is remarkably free from stains of iron-oxide. Some small areas of wash yielded from ten to twenty ounces of gold to the load, but very much poorer ground, even to a few pennyweights to the load, has been worked out. Thousands of ounces of gold were taken from the lead, and at the time of the "rush" a large number of miners were finding gold. At the present time perhaps a dozen men might be seen fossicking about the claims, working out little patches of wash which had been missed or neglected by previous miners.

The Ironstone Lead.—This lead is situated at the head of the Dead Horse Lead, and has a north-westerly trend towards the Copperfield Road and the Clermont Racecourse Flat. Where it begins above its junction with the Dead Horse it is a surface lead, but at its lower end the depth of sinking is nearly twenty feet. The gold found is said to have been coarse, and some parts of the lead were fairly rich.

James' Lead.—The lead of this name appears, from a casual observation, to be a small branch of the Dead Horse Lead, both from its proximity and trend, but, with all the prospecting which has been carried on about it, no connection has been found between them.

The conditions are different in the two leads, and there is no doubt the James' Lead is of subsequent formation to the Dead Horse, and approximately of the same age as the Ironstone Lead. As with the latter, the wash in it is well mixed with ironstone pebbles, and carried rich patches in some parts of it, and, while it occurs as a surface wash at its head, to the south-east it becomes deeper near the Dead Horse, where some of the shafts are between thirty and forty feet deep.

The Basalt Wash.—Reference has been made previously to this deposit in connection with the Bower Bird and Dead Horse Leads. Its extent is very great, as shown on Map 2, but it has never been proved to be a rich deposit. It occurs on the eastern and western sides and near the northern end of the Dead Horse Lead, and also between this and the Bower Bird Lead. On the western side of the Dead Horse it extends towards the White Hill Lead for about a quarter of a mile, where some slate outcrops evidently form the boundary of it in this direction. On the eastern side of the Dead Horse the basalt wash gradually disappears below more recent surface deposits.

In the wash there are pebbles and boulders of felsite, basalt, rhyolite, chlorite slate, quartz, magnetite, &c., some of which are not known *in situ* anywhere in the district. The gold found did not occur as a distinct trail in the wash, but was met with irregularly in areas having no particular shape or trend.

White Hill and Blister Hill Lead.—One end of this lead is located in a gully at the west side of the "Basalt Wash" close to a slate outcrop, and in the block of ground reserved for a police paddock. It was thought that the lead might continue on the north-east side of the gully, but several prospecting shafts have been sunk without finding any extension of it in that direction. From this gully the lead (which at this end is called the White Hill Lead) trends towards the west to another parallel gully, and, continuing on the other side of this (where it is called the Blister Hill Lead) in the same direction, is lost in the wet ground near the Copperfield Road at Duncan's old puddling machine.

The wash resembles that of the Bower Bird, but it has not yielded much gold, although some of i gave five ounces to the load. The bottom is chloritic schists, very much decomposed and ironstained in places.

The general trend of the lead indicates a possible connection with the Bower Bird and Wild Cat Leads, and it also contains pebbles of the sandstone and "pilot stones" found in those leads. The depth of the bottom of the wash near Duncan's machine is thirty-five feet from the surface, and there is only a rise of a few feet up to the eastern end of White Hill Lead near the "basalt wash," while the altitudes of this end of the lead and the western end of the Bower Bird Lead are about the same. Allowing for alterations in level by small earth-movements, there is a possibility of the leads of Blister Hill, White Hill, Bower Bird, and Wild Cat being once continuous, which the more recent basalt wash has partly replaced. If the "pilot stones" were found in the Dead Horse Lead on the northern side of the wash-out, a matter which has not been settled, then the White Hill Lead probably joined the Dead Horse at its northern extremity where the greenstone rock occurs on the bottom, and, from this part of the Dead Horse Lead, to have trended southerly to join the Bower Bird.

McDonald's Flat.

McDonald's Flat is situated about three miles south of Clermont, as shown on Map 2, and is a centre around which a great number of leads occur. There is also a large number of reefs in the neighbourhood, some of which very probably have shed their gold into the leads close to them. If there are any of the leads which should be mentioned as being conspicuous, perhaps it is the Clermont Surface Lead and the Deep Creek Lead, both having yielded a considerable amount of gold since they were discovered. There are as well many other leads which have been very prominent in giving large yields of gold at one time or another.

Clermont Surface Lead.

This lead is situated to the north-east of McDonald's Flat, and from near the McDonald's Flat-Clermont Road has a south-easterly trend. From the contour lines showing the altitudes of a number of points along the course of the lead, as shown on Map 2, it is impossible to say which end should be considered the head. Near the road referred to it is nearly forty feet higher than where it crosses a gully about a quarter of a mile away to the south-east, but further along its course on the other side of this gully it rises up again to the level of and close to the Prince of Wales Reef.

All over the surface of the ground along this lead some gold has been found, and the wash has been worked over and over again by dry-blowers and jiggers. Even now the lead is supporting a number of men working with these machines. The wash is free from "pug," and the gold is shotty and coarse—two features which make the wash so favourable for dry-blowing.

Deep Creek Lead.

It must not be supposed, from the name of this lead, that it occurs in the channel of Deep Creek. The creek heads near the road between Clermont and McDonald's Flat, and trends south-easterly to Hines' Paddock (Sel. 5v.), where it is lost in the alluvium on the east bank of Sandy Creek. The Deep Creek *Lead* starts on the western side of Deep Creek, near Long Gully, trends north-easterly across the creek, then slightly north of east for about half-a-mile, where it is lost.

There is a fall from west to east, but not very pronounced, while the surface above is slightly undulating. The sinking is deep in places; and the wash is fine and white, and contains boulders and pebbles of white quartz. The bottom is slate, more or less decomposed, but, as the whole of the country about here is covered by black soil, no outcrops of this rock are exposed near the lead on either side.

The lead was comparatively rich near Deep Creek, but towards the eastern end the wash became too poor to take out. Further to the east a few prospecting shafts were sunk to find out if it continued in that direction, but no defined lead was found, although a large quantity of water was met with. The tailing out of the lead in this direction and the presence of this body of water will be referred to again when discussing the results of the bores which have been sunk by the Clermont Prospecting Association to the north of them. The Deep Creek Lead was opened in 1894.

The Red Flag Lead is a branch of the Deep Creek Lead coming in on the north side. The lead is shallow and very short, and the gold always found in patches. Generally considered, it was never of much importance.

Leads Falling into Deep Creek.

All the known leads falling into Deep Creek are from the western side, where the slates and quartz reefs are exposed. None have been found on the eastern side, the surface there being covered with black soil, with a decomposed basalt below.

The leads are not all worked out, although there are only a few miners now working on them, some treating the old tailings and the surface soils with blowers and jiggers, others reworking old claims, and a few prospecting in new ground.

Bald Hill Lead.—This was opened in 1896 by a prospector finding gold with a dry-blower. It is situated close to the McDonald's Flat-Clermont Road, from which it trends easterly along Bald Hill towards Deep Creek. It is a surface lead near the road, but lower down the hill the sinking is

fifteen feet, and further on it is exposed again as a surface deposit. The wash on the surface, different from the deeper wash, has no clay in it, and therefore favourable for blowing or jigging. The bottom rock here, as in all the other leads in this part of the district, is generally a clayey, talcose, or chloritic slate.

Prince of Wales Gully.—There is no defined lead in this gully, but gold has been found in a number of watercourses close to the Prince of Wales Reef. The evidence obtained from the old workings show that the gold has been in a shallow deposit spread very much over the surface.

Scotchman's Gully.—The lead in Scotchman's Gully heads towards the Prince of Wales Reef. It is partly a surface wash, but in some places the sinking is about twenty feet. A number of men are working on it at present—some on new ground, and others working over again the old wash. The gold is coarse, as in all the leads about here except the Long Gully Lead.

Red Hill Lead is a branch of Scotchman's Gully Lead, and from one of the ridges it falls down from the west rather abruptly into this creek. Although considered a branch of the Scotchman's Lead, it is evidently a much older formation.

Puddler's Gully.—The lead in the channel of this gully yielded some rich patches of wash when it was first opened some years ago. The gold was coarse, and the sinking generally shallow. A number, of men have recently been working here on some of the old ground.

Long Gully Lead.—This lead also heads at the Prince of Wales Reef, from which some of its gold most probably has been derived. The lead, however, is noted for much of the gold being in a fine condition, while the Prince of Wales reef gold is coarse. The lead follows the course of Long Gully, and connects with the Deep Creek Lead. The workings are all shallow, none being deeper than twelve feet, and the bottom is slate. Close to Deep Creek the slate in the bottom of this lead is coloured bright green, and is chrome-bearing, but the percentage of this metal in the rock is small.

Chinaman's Gully and Nuggety Gully are other branches of Deep Creek south of Long Gully, where gold has been found in the bed of the streams and also on the sides of the ridges in which they have their source. Between the two gullies a small surface lead has been worked on the top of a ridge.

Flyspeck.

This lead is situated on Deep Creek, about a mile and a-half south of the Long Gully Lead. It however, does not fall into that creek, being of earlier formation, the creek cutting across one portion of it.

It does not appear to have any defined course, simply being an irregular shaped deposit extending over a large area and partly occupying the gentle easterly slope of a ridge, as shown on Map 2, with Deep Creek cutting across a portion of its easterly boundary. The sinking is from twelve to forty feet, with black soil on the surface and a clay slate forming the bottom. The deposit in the main "trail" is much older than those of Deep Creek further north, and, from the presence of bituminous coal bands and shales in some of the shafts, very probably is of Permo-Carboniferous Age. Other "trails" are younger, and from the fossil bones found in them Mr. de Vis, the Curator of the Queensland Museum, determines their age to be Post-Pliocene.

The yield of gold in some of the claims was as much as eighteen ounces to the load, but much of the wash only gave three pennyweights. No sudden variation in the richness of the wash was experienced in the workings, and, although rich and poor parts occurred, generally the wash was fairly uniform.

A "rush" of nearly 500 miners took place to this lead when the discovery was made in 1894, but twenty-five men would about make up the total number at the present time working on it.

Leads to the South-East of McDonald's Flat.

Hard Hill, Bamford's Hill, Tramway Gully, Blackie's Mistake (Gully).—These leads have all an easterly trend, and fall into the unnamed creek which drains McDonald's Flat, and which for purposes of reference will be called McDonald's Creek. None of the leads are very long, and while some are located in the gullies others occupy the tops of the ridges. At one time they supported a large population of miners, but at present only a few miners are to be seen working on them. The miners are principally engaged re-working some of the old claims, or else dry-blowing or jigging the surface soil or old heaps of tailings.

The Hard Hill Lead, which was discovered fifteen years ago by Mr. Julius (?), trends along the top of a ridge, then falls into the northern branch of the Tramway Gully Lead. Bamford's Hill Lead was discovered about thirty years ago by a miner named Bamford. It is isolated from the Tramway Gully Lead, although the distance between the two is very short. Blackie's Gully (or Blackie's Mistake) was opened at about the same time as the Hard Hill Lead.

On the hills the leads are surface deposits, while in the gullies the wash is covered in places with several feet of recent alluvium. In Tramway Gully the wash is sometimes twenty feet below the surface, and in Blackie's Gully it is about twelve feet. The wash has not been rich, on an average, but rich patches have been found in which half-ounce pieces of gold were common, one slug found in Tramway Gully weighing ten ounces. In all of these leads, the absence of slate débris in the wash is very noticeable, although the bottom is slate, a feature made more conspicuous by the presence of slate débris on a similar bottom formation in the Honeycomb Lead a little further west.

Honeycomb Lead.

This lead is situated to the south-west of McDonald's Flat, and is isolated from all the other leads in the neighbourhood. The discovery of the lead was made in 1894, and shortly afterwards 200 men were prospecting along the course of it.

The lead at the head of the main gully occurs on the surface, but the further east it was traced the deeper it became, and the lower end could not be bottomed at twenty-five feet of sinking because of the presence of too much water, this also preventing the lead being further traced towards the east. Possibly the yields of gold at this spot were too low to warrant expenditure of money in keeping the water down.

The bottom of the lead is slate, and there is abundance of débris from this rock in the wash, in which also ironstone and quartz pebbles and schist fragments are common. The lead has been considered a good one, and has yielded more gold than the Flyspeck Lead, but the wash was patchy, the gold not being so regularly disseminated through it as in that lead.

Leads Falling into Chinaman's Flat.

McGuiness' Gully, Bamford's Gully, Brigalow Lead, Madden's Gully.—McGuiness' Gully and Bamford's Gully head at the dividing ridge separating McDonald's Flat from Copperfield waters. Brigalow Lead is a portion of Chinaman's Flat where Garden Gully joins it, and Madden's Gully heads on the western side of the divide near the end of the Clermont Surface Lead, and close to the Clermont-McDonald's Flat Road.

The leads were opened about sixteen years ago, and a considerable amount of prospecting has been carried on since that time. Bamford's Gully and McGuiness' Gully have been extensively worked, but neither of the leads were very rich. The Brigalow Lead is being worked now by a few miners, but the yield of gold is very poor. The wash is on the surface, and is very much ironstained and clayey.

From a general point of view the leads are narrow with a large amount of wash, yielding about four or five pennyweights to the ton, with a tendency to become richer on the high ground and poor on the low ground. The bottom all over this area is slate—siliceous, clayey, or chloritic—with an intrusive felsite in places forming a bar across the lead. The maximum amount of sinking on Chinaman's Flat was twenty-five feet, and some of the claims above the bar could not be bottomed because of the abundance of water.

Alluvial Deposits East of Copperfield.

These deposits were well worked in the early days of Copperfield, but even now a few miners are able to make a living by prospecting about the old workings. Mr. Rands, in his Report (*l.c.*; page 6), states that "between this reef [the Crown Reef] and the town of Copperfield, rich patches of alluvial gold were obtained from a small hill; one man got one hundred ounces in a foot or two of ground."

THE REEFS.

It is proposed to describe, first, the reefs at the northern end of the district, including the Venus Reef and those recently discovered in the Western Creek country, then those in the north-west and south-east belt of slate between McDonald's Flat and Deep Creek, next Bedford's and other reefs to the south-east of McDonald's Flat, and, finally, those around Copperfield.

Many reefs which were worked and abandoned years ago are not known at the present time by their old names, but, as there is a probability of some of them being identified under other names, descriptions will be included for reference.

The Western Reefs.

These reefs are situated about twenty-four miles north-westerly from Clermont in country consisting of micaceous and clayey slates with innumerable quartz leaders and ironstone veins and "blows." Near the reef there are outcrops of decomposed acidic dyke rocks which may have some bearing on their trend and continuity.

The Pioneer Reef has a strike north-west and south-east, and consists of quartz with some included clay slate, and between walls of a coarse felspathic slate. The strike is well defined, but the width and inclination are variable, the reef sliding and pinching to a few inches on the less inclined portions, and widening again, perhaps to a couple of feet in the steeper parts. The stone in the reef between the walls is rich in patches, with a thickness no greater than two feet, but outside the reef for about a foot into the walls gold can be obtained, making a maximum thickness of four feet of both rich and poor stone.

How far the reef extends in depth cannot be stated, as there is no evidence to warrant an expression of opinion, but, should it compare with its surface extension, there will be no doubt of its permanence.

The shafts have been sunk for prospecting purposes, but while doing this some of the stone has been raised for treatment. Six tons of stone taken to Clermont yielded returns at the rate of five ounces of gold to the ton, and another sixteen tons gave three ounces seven pennyweights per ton. Other parcels of stone from here have given returns of over three ounces to the ton; one lot of four tons, stripped from all along the reef for fifty feet, gave three ounces to the ton; and another one from the same place of three tons yielded five and a-half ounces to the ton, or an average of just over four ounces.

The "New Reef" runs parallel with the Pioneer Reef, and is composed of a felsite with quartz veins traversing it and more or less ironstained. It is exposed for about one mile, and gold-bearing stone has been traced along its outcrop for 1,000 feet. The walls are slate, and where they come in contact with the felsite some gold is found in them. There has been a small amount of trenching across the reef, but not sufficient to determine what it is in size, &c., but from the outcrop it does not appear to be very regular, bulging out to several feet in some places, and pinching almost out of sight in others.

Both the Pioneer and the New Reef present many promising features, but the absence of treatment works and the general scarcity of water in this part of the district retards development, the cost of carting the stone from the mines so many miles into the Clermont batteries being exceedingly heavy.

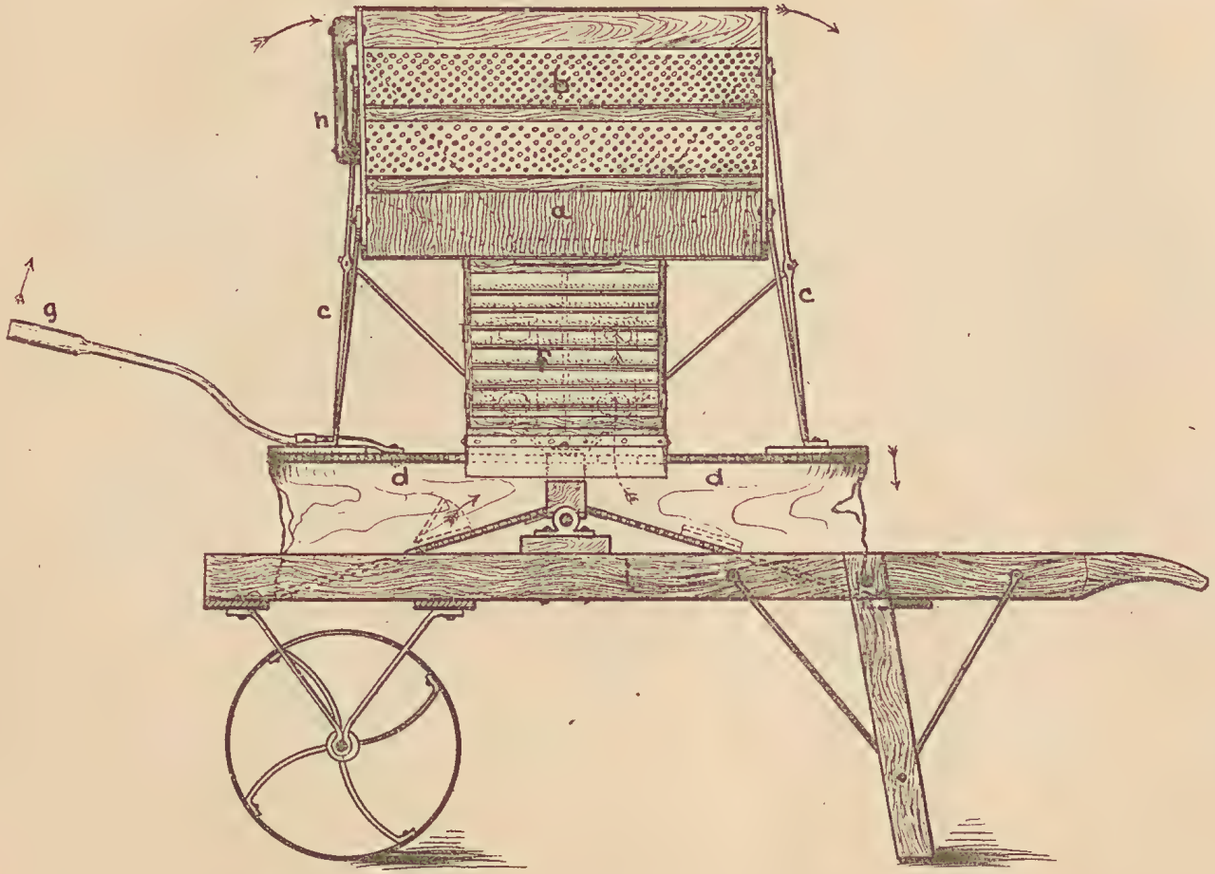
Italian Reef.

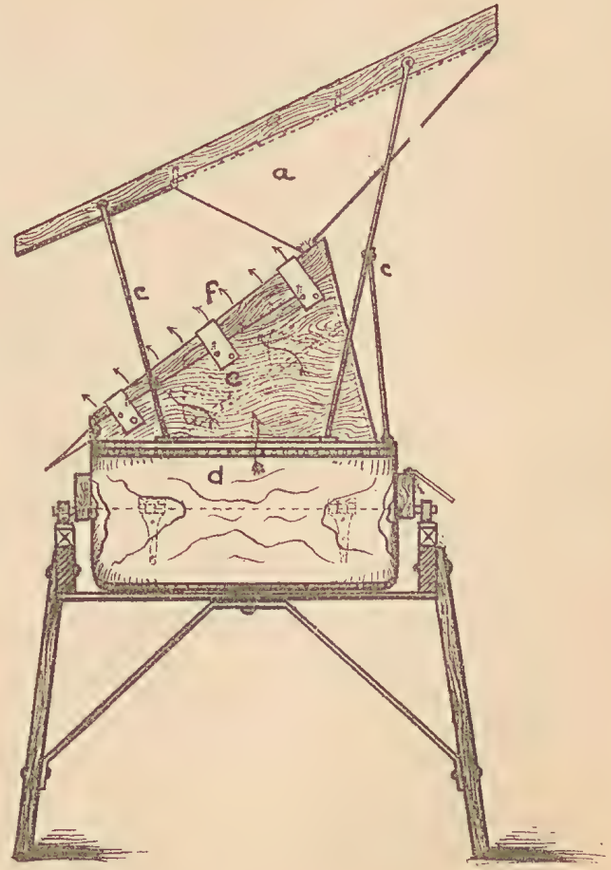
This reef is on the Drummond Range and close to what is known as the "Seven-mile" Diggings on the track between the Western Reefs and the Blair Athol Coal Mines.

The reef is well defined, three feet thick, and has slate walls. Two tons lying on the surface show gold freely, but no battery returns are available. A shaft has been sunk to a depth of fifty feet, and from this a drive has been put in across the country for 100 feet and then forty feet along the reef. The shaft was put down on the footwall, this on the outcrop being mistaken for the hanging-wall, and not finding the reef in the shaft as expected, the cross-drive was put in before it was found.

CARLSON'S DRY BLOWER

Scale 0 1 2 3 Ft.





Reference

a. Hopper
b. Hopper screen and riffles
c. Rigid supports for hopper
d. Double bellows, bottom movable.
e. Wind chest and valves
f. Perforated zinc screen and riffles
g. Handle for right hand
h. Handle for left hand
i. Barrow frame

Accompanying Report on the Clermont Goldfield. By B. Dunstan. 1902.

GEOLOGICAL SURVEY OF QUEENSLAND

Venus Reef.

This reef is situated south of the Blair Athol Coal Measures, and about a mile north of the Venus Hotel, on Bathampton Creek. Referring to the reef, Mr. Rands, in his Report in 1886 (*l.c.*: page 4), states that:—

"It bears north-west and underlies 35 degrees to the south-west. The workings are only twenty feet deep. A drive was put in the side of the hill in which the reef is situated, cutting the reef at a depth of twenty feet. This is another instance of what is very commonly seen—the waste of money by putting in drives instead of sinking shafts when a hill has an inclination of much less than 45 degrees.

"The schists here are dipping 30 degrees west.

"This, too, is a mullocky reef, in many respects similar to the Cumberland Reef. It contains more quartz (in many places being almost entirely made up of small, more or less angular, broken up pieces of quartz, cemented with a clayey cement). The average width is about two feet. The walls are not well defined, and can only be traced at times by a reddish colouration from the infiltration of oxide of iron on both walls. This reef was reported to go three or four ounces of gold to the ton, and I am informed that a twenty-ton crushing went one and a-half ounces per ton. The prospects now being obtained are by no means good."

Dr. Jack, who inspected the reef in 1894, when more work had been carried out, refers thus to it in his Report (*l.c.*: page 14):—

"This reef bears north 15 degrees west. In Betterich's workings, which are reached by a shaft twenty feet deep, there are vertical 'mullacky' veins of schistose débris without much quartz. There are leaders in the bedding-planes of a clay schist, which underlies about 40 degrees to the west crossed by vertical leaders. The gold appears to be best in the latter. The present holder of the mine single-handed has made a living from it for the last six years.

"Madge's Shaft, eighty-seven feet north of Betterich's, is vertical for forty-five feet, and follows the underlie for sixty-four feet. Owing, however, to an accumulation of water, I was unable to see the latter. I was informed that £1,900 worth of gold was obtained from the Venus Reef before the removal of the battery."

It seems the reef was opened in 1886, and up to the present has been traced for 200 feet along the surface. The reef is not defined in any way, in places consisting of mullock, fragmentary quartz, and cement. There are bodies of quartz occasionally to be met with, but they are invariably very poor in gold. Where the quartz and mullock leaders traverse the fine schist and slate formation, the yield is always about an ounce to the ton. At present the reef is not being worked.

Cumberland Reef.

"This reef is situated just across Sandy Creek, north of the township. It bears W. 15 degrees N. with an underlie of 45 degrees to the south-south-west. The country consists of micaceous and hornblendic schists dipping to the north-north-east.

"The gangue of the so-called reef is a mullock, consisting of broken up schist with quartz, coloured throughout with oxide of iron, which gives it a rusty appearance. It is from three feet to three feet six inches thick. Near the bottom of one of the shafts a leader of quartz is forming containing gold. This is not a true reef, but merely the space between the walls of a dislocation in the rock filled in with the rock débris, into which the gold must have since infiltrated. The crumpling and contortion of the schists close to the reef give ample evidence of the great pressure and strain which brought about the dislocation.

"The last crushing went only 5 dwt. of gold per ton."—(*W.H.R.*, 1884, *l.c.*: page 4.)

No work has been carried on at this reef for a number of years.

Ferruginous Quartzite Belt.

This belt of quartzite is about a mile and a-half south-south-west of Clermont, at the head of the Dead Horse Lead.

Shafts have been sunk on it, trenches have been cut through it, and parcels of stone have been tested, but, so far, the yield of gold has been too low to make the working of it profitable. The belt is of enormous proportions, evidently an altered sedimentary formation, and might be made payable if worked on a very large scale.

General Character of the Reefs around McDonald's Flat.

The reefs around McDonald's Flat occupy a belt of country having, as stated before, a north-west and south-east trend, a belt within which thousands of ounces of alluvial gold have been obtained in the past. In the centre of this belt, on the eastern side of McDonald's Creek, there are immense "blows" of white quartz which have been proved to be quite free from gold—as nearly all such masses of quartz are in the Clermont District—while to the north-east and south-west, on the edges of the belt, the reefs of smaller dimensions and some leaders have been worked with very satisfactory results.

Although there are, of course, differences in the reefs of this belt in regard to trend, inclination, and other such features, yet they have much the same general character. They may be described as narrow reefs which occasionally bulge out to wide quartz formations, and where abnormal in width are either very poor throughout or else the gold is limited to a very small portion of it. Some of the leaders of quartz and mullock have been exceedingly rich, and from the haphazard way in which they have been found there is hardly any doubt but that many more will be met with if the prospecting is carried on systematically.

Sultan Reef.

The Sultan Reef is located about a quarter of a mile from the Clermont-McDonald's Flat Road, and is close to the head of Madden's Gully. (See Map 2.)

The reef has been abandoned for some years, and no information can be obtained concerning it. From the amount of material brought up from the shaft, however, the workings must be extensive. All this material on the surface is talcose schist, from which it might be inferred that all the stone taken out of the reef has been carted away and treated. The strike of the reef is west-north-west, and 200 yards of the surface of the reef has been worked out.

Reefs near the Clermont Surface Lead.

These reefs are just at the north-western termination of the Clermont Surface Lead and close to the Clermont-McDonald's Flat Road. The reef furthest east (see Map 2) has a trend N. 35 degrees W., and the prospecting work on the surface has revealed a quartz vein six inches thick widening in places to a mass of leaders several feet thick. The outcrop has been exposed along the surface for about 100 feet. The walls, which are nearly vertical, are of talcose slate, and the quartz in the reef is traversed by small veins of calcite, siderite, and magnetite. Some of the stone from here, when crushed, yielded four pennyweights of gold to the ton.

The second reef is 100 yards further west, has the same bearing, the same class of stone, and similar walls, and opened to about the same extent. Further along the line of this reef an outcrop of heavy ironstone shows a staining of a bright green talcose mineral giving chromium reactions, being probably a chrome-bearing talc.

Biddy Walsh Reef.

This reef is on the eastern side of the Clermont-McDonald's Flat Road and close to the Clermont Surface Lead. The strike is east and west, thickness from six inches to one foot, underlies to the north at about one in ten, and has walls of chloritic and talcose slate—the footwall being the harder of the two. The workings consist of a number of shallow shafts and trenches, and the reef has been traced for a distance of about 400 feet along the surface.

The quartz contains abundance of pyrites in which also siderite, magnesite and dolomite are present. The returns from the stone from two battery crushings show that ten tons gave thirteen pennyweights of gold to the ton, and another ten tons gave half-an-ounce. It is said these yields can be maintained from the stone now in sight, although a lot of poor stone would require to be left in the stopes or thrown over the mullock heap.

The gold is invariably fine in grain, and possibly the returns would be higher if the battery treatment were to be supplemented by subsequent treatment of the tailings for fine gold.

Prince of Wales Reef.

The Prince of Wales Reef is situated on a ridge at the south-eastern termination of the Clermont Surface Lead, and where a number of surface leads falling into Deep Creek have their origin.

The reef has no defined boundaries, but is very conspicuous on the surface where some large irregular masses of white quartz are exposed to view. The gold is not contained in these large outcrops but in some quartz leaders in the talcose and chloritic slate close to them, and, although portions have been taken out having a thickness of five feet, it is the two leaders, six and eight inches thick respectively, which have yielded most of the gold and the best returns.

Several shafts have been sunk on the reef, some for taking out the stone but most of them for prospecting purposes. One hundred tons of stone from the reef have been crushed, portions of which have yielded twenty-eight pennyweights of gold to the ton.

Victoria Reef.

This reef is about a quarter of a mile south-east from the Prince of Wales Reef, and about half-a-mile westerly from the miners' wells at the creek at McDonald's Flat (Creek). The reef is about three feet wide, with slate walls and a northerly underlie, has been traced a short distance along the surface, and worked down to the water-level at eighty feet. The returns show that 117 tons were crushed for returns of from five to seven pennyweights of gold to the ton (see Appendix). The reef has been abandoned for a number of years.

Doctor's Reef.

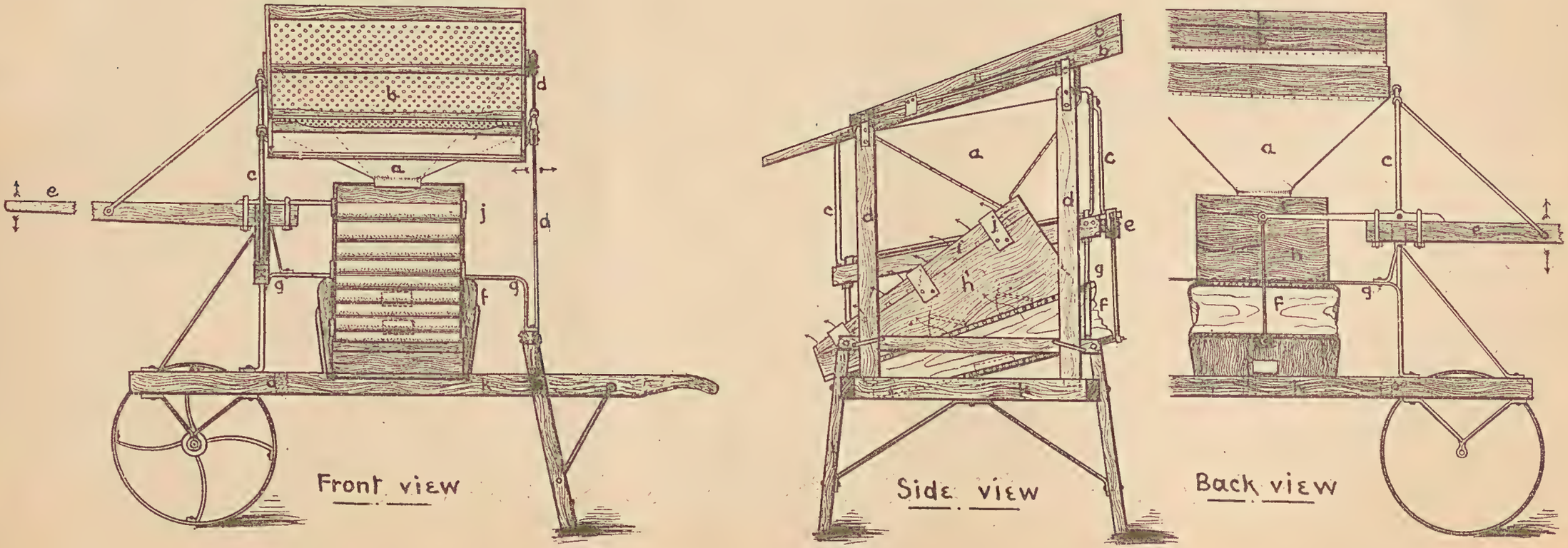
The Doctor's Reef is about eight chains south-west from the Victoria Reef, with the same formation in the walls as that reef, and the same bearing and inclination. It consists of a bunch of parallel leaders of varying thickness, of which one of eight inches is the largest. The workings consist of shafts and levels, the main shaft reaching to a depth of 180 feet. The bottom level is at 110 feet, and has been driven for a distance of thirty feet. The water level is at eighty feet, below which no stone has been taken out for treatment. It is stated that the yields were over an ounce to the ton, and an old copy of the *Peak Downs Telegram* (see Appendix) shows that one crushing of thirty-one tons averaged over twelve and a-half pennyweights of gold, and another one of fifteen tons averaged two ounces.

Croydon Reef.

The Croydon Reef is situated about half-a-mile south-south-west from the Doctor's Reef, and is close to the eastern side of McDonald's Creek. The reef strikes east-south-east, has slate walls, and underlies northerly at 30 degrees, and, including parallel leaders, is about three feet in thickness.

RANKIN'S DRY-BLOWER

Scale 0 1 2 3 Ft



Reference

a. Hopper	d. Wooden springs	g. Bellows support	j. Flanges for fixing screens in position
b. Hopper screens and riffles	e. Handle	h. Wind chest and valves.	k.
c. Iron supports for hopper, one side	f. Single bellows, bottom movable	i. Perforated zinc screen & riffles	

Accompanying Report on the Clermont Coldfield. By B. Dunstan. 1902.

GEOLOGICAL SURVEY OF QUEENSLAND

The workings show that all the stone has been removed for about twenty feet below the surface although one of the shafts has been sunk to forty feet.

Another leader to the north-east has been opened by trenching, and has an east and a west strike, and an underlie of 45 degrees to the north. Further than the trenching, nothing has been done to work it.

Grick's Reef.

The position of this reef is to the west of McDonald's Flat, on a ridge crossing the western boundary of Selection 14.

It has a strike W. 15 degrees S., has no defined walls, and consists of a number of small bodies of quartz and leaders of mullock. It has a northerly underlie of about 30 degrees, but in the workings there is evidence of a change to a steeper inclination. The reef has been opened for sixty feet along the surface, and has been traced below to a depth of sixty feet. Further along the line of strike a shaft has been sunk to a hundred feet, but without getting on to the auriferous stone. The width of the reef or leader is very irregular, and the labour has been expended principally in picking out small bodies of rich stone for crushing.

The returns from the crushings of stone at the Clermont batteries were so satisfactory that it has been deemed advisable to erect a crushing plant on McDonald's Flat to treat the stone from this and other reefs in the neighbourhood.

Robertson's Reef.

From Grick's Reef this is situated about three-quarters of a mile in a westerly direction, and is near the head of McGuiness' Gully.

The reef forms two parallel bodies of quartz about six feet apart, having a strike E. 20 degrees S., a southerly underlie of 30 degrees, and a thickness varying from two feet to as many inches. The workings are sunk to thirty-five feet, and consist of shafts, drives, and some irregular work.

The yields from this reef have been from thirteen and a-half pennyweights to five ounces of gold to the ton, the latter yield being obtained from a parcel of eleven tons in 1899. Since then other very satisfactory crushings have been made.

Bedford's Reef.

The outcrop of Bedford's Reef is between the two branches of Tramway Gully on the southern side of McDonald's Creek, and, as shown on Map 2, is close to a number of leads which have yielded a considerable amount of gold. The reef has an almost east and west strike and an underlie to the south, the angle of which varies, as the rather extensive workings show.

The most westerly workings are near the northern branch of Tramway Gully, close to the southern side of Hard Hill. Here a shaft was sunk to prospect an outcrop of ironstone, but came to a slate formation at twenty feet. The ironstone carried small bunches of quartz containing gold, but whether poor or rich could not be ascertained. The underlie in this shaft is 45 degrees, and the stone is said to have pinched out on the south side of the shaft, which now is abandoned.

At one and a-half chains to the north-east of this another one has been put down to 100 feet, but without finding a reef at all. To the north of this shaft a fourth one was sunk, and at fifty feet struck some leaders of quartz a few inches thick associated with which was some ironstone containing a small amount of gold. The walls are of slate. These shafts are also abandoned.

A north and south trench to the east of the fifth shaft was made for thirty feet, and extended to the east of the fifty-feet shaft. The object was to cut across some small exposed quartz leaders and quartzose ironstone which, it is said, contained gold. These were exposed, but nothing further has since been done.

At three and a-half chains further towards the east another shaft was sunk to a depth of sixty-five feet on the underlie of a quartz outcrop, but at a depth of twenty-five feet a yellow and red cement or crushed country rock was met with, and with slate on either wall continued down to the bottom of the shaft. A drive at fifty feet connects with the level at this depth in the main workings further east.

The main shaft is sunk vertically to thirty-two feet, and then at an underlie of 20 degrees down to fifty-six feet, and then at an underlie of 13 degrees to a further depth of eighteen feet to what is called the seventy-feet level. Below this the shaft has an underlie of about 5 degrees, being nearly vertical to the bottom of the shaft at 165 feet.

Between the fifty-feet level and the seventy-feet level a large amount of stone has been taken out and treated. On the footwall, or north side, the reef gradually makes into leaders alternating with slate country rock. Notwithstanding this, however, on the fifty-feet level from two to six feet of the reef has been removed and crushed. At the same level there is evidence of a *dip-faulting* on the footwall side of the reef, and the slates here have been crumbled from the movement.

At the seventy-feet level the stone taken out was considered good, but the country is broken, and the reef is not defined. Below this, the water level, no stone has been removed for crushing.

At the bottom the reef has been driven on, and is from five to eight feet thick, of which along the level about three feet has been taken out. The hanging-wall is well defined, but the footwall is very much crumpled and disturbed. Gold is seen in the face of this drive, but evidently not much work has been done there recently.

Generally considered, the whole of the workings show that the good stone has been found on the hanging-wall, and, as the footwall side has been neglected, it may be assumed the stone there is poor or not sufficiently rich to pay under existing circumstances.

The returns below will show the results of treatment of the stone from this mine, and also the positions from which it was taken.

Two other shafts have been sunk on the eastern side of the main shaft. One was put down, two and a-half chains away, to a depth of eighty feet, but did not find the reef at all, being in slate to the bottom; the other shaft, at a further distance away of thirty-five feet, was sunk to about the same depth. In this shaft a small body of reef-stone was found, and when crushed yielded returns too poor to pay expenses. The cement previously referred to was found in this shaft, but the other shaft close by was sunk too far to the south to strike it.

RETURNS FROM BEDFORD'S REEF.

Quartz-reefing Lease No. 72.

(From January, 1899, up to the end of June, 1901.)

Battery Returns.

Date.	Tons.	Yields.	Average per Ton.	Bank Returns.	—
		Oz. dwt. gr.	Oz. dwt. gr.	£ s. d.	
1899—January ...	26	37 10 0	1 8 20	154 3 7	See footnote (*a*)
April	42	52 0 0	1 4 18	119 18 6	„ „ (*b*)
June	77	70 14 0	0 18 8	262 7 3	„ „ (*c*)
December ...	116	87 0 0	0 15 0	294 14 0	„ „ (*d*)
1900—June	150	178 0 0	1 3 22	534 2 0	„ „ (*e*)
September ...	59	73 3 0	1 4 19	246 7 10	„ „ (*f*)
Total	470	498 7 0	1 1 4	£1,611 13 2	

	£ s. d.	£ s. d.	
Returns from all concentrates realised ...	150 15 2	= 0 6 5	per ton of stone
All cyanide returns (320 ounces)	1,033 1 1	= 2 3 11½	„ „
Battery returns...	1,611 13 2	= 3 8 6½	„ „
Total	£2,795 9 5	= £5 18 11	„ „

(*a*) Out of main shaft in sinking to twelve feet.
(*b*) Out of main shaft in sinking to fifty-feet level.
(*c*) Out of fifty-feet level at west end of main shaft.
(*d*) Out of western stopes between surface and fifty-feet level.
(*e*) Out of stopes on the sides of the main shaft.
(*f*) Out of stopes between fifty-feet and seventy-feet levels on west side of main shaft.

Somersetshire Reef.

The information concerning this and the four following reefs are taken from Mr. Rands' 1886 Report. They have not been identified, having been worked and abandoned many years ago. They are inserted for general reference, and also with the hope that they may ultimately be correlated with some of the McDonald's Flat reefs probably now known by other names:—

"This bears E. 10 degrees N.; underlies at first slightly to the north, but in the deepest shaft (160 feet) it bends around to the south. It averages about four feet in width, with well-defined walls. It is of a white quartz, which in parts is arranged in perpendicular layers. Gold was visible in many of the blocks. At 160 feet in depth mundic occurs, which I was informed assayed well. The reef has been followed for over half-a-mile. The country consists of purplish and white micaceous schists, dipping 35 degrees south-south-east. Scrubby Gully, which was the best in this part of the field, heads from the neighbourhood of this reef.

"The earlier crushings were very good. I obtained returns of three of them:—Forty-six tons yielded five ounces of gold per ton. Seventy-five tons yielded also five ounces per ton; and forty-three tons yielded three ounces five pennyweights of gold per ton. The later crushings again are poorer:—

Year.	Tons.	Gold per Ton. Oz. dwt. grs.
1882 ...	23 ...	1 1 17
1883 ...	15 ...	0 15 0
1885 ...	7½ ...	0 7 0"

—(*l.c.*: pp. 6, 7.)

"St. Patrick's Reef.

"Running W. 40 degrees N.; perpendicular. Very similar to the Somersetshire Reef, and lies in similar country. It is from fifteen to eighteen inches in width. The last crushing went eleven pennyweights of gold per ton; the earlier crushings from thirty pennyweights to three ounces of gold per ton. The deepest shaft is 130 feet, where mundic is appearing; a trial crushing from this depth went thirty pennyweights per ton."—(*l.c.*: page 7.)

"The Lady Eleanor Reef

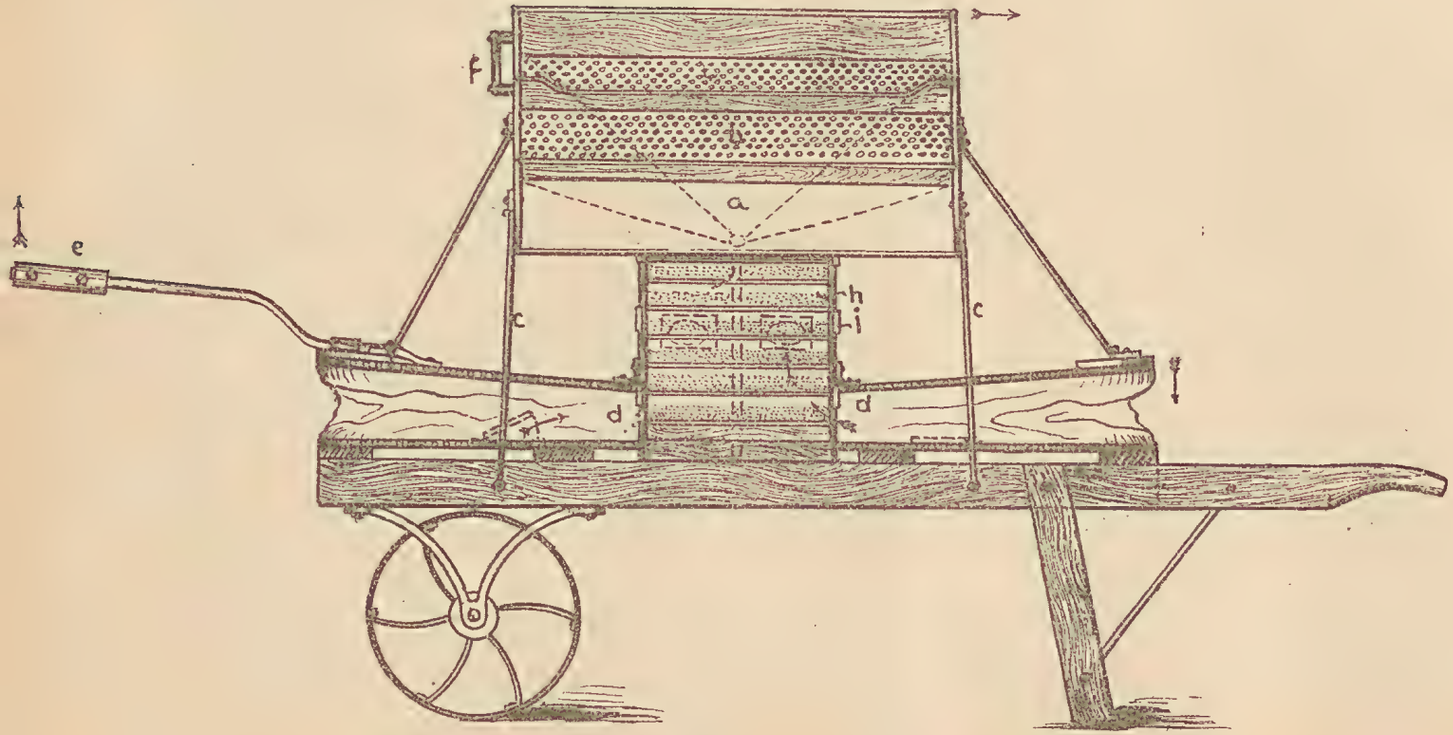
"Bears E. 10 degrees N. A shaft of a few feet in depth has been put down on it. A trial crushing of eight tons only gave ten pennyweights of gold per ton."—(*l.c.*: page 7.)

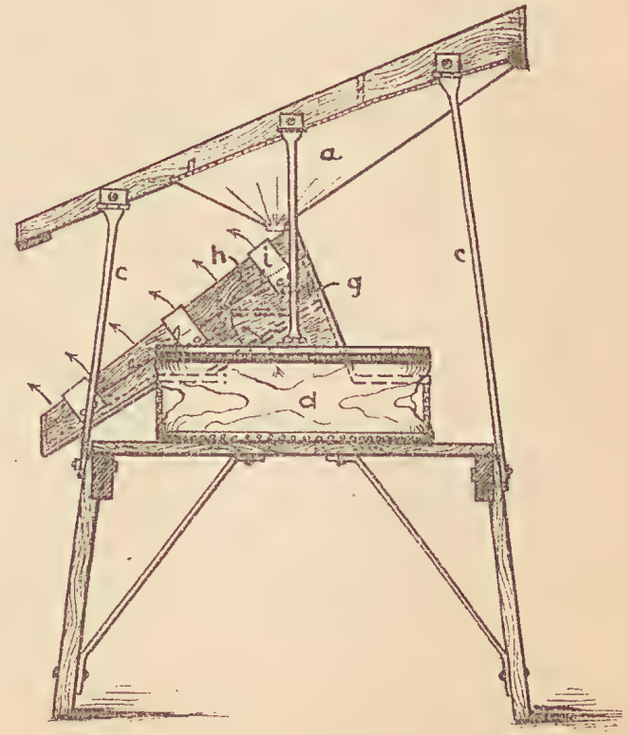
"The Christmas Reef

"Bears E. 15 degrees N., and underlies 20 degrees north. It has only been sunk on to a depth of thirty feet; and there the reef consists of two quartz leaders separated by about a foot of mullock, consisting of broken up schist. These leaders are from six inches to one foot in width. The country is a silvery micaceous schist, dipping 40 degrees south-east."—(*l.c.*: page 7.)

BUHRE'S DRY-BLOWER

Scale 0 1 2 3 Ft.





Reference

a. Hopper

b. Hopper screen and riffles

c. Hinged hopper supports

d. Double bellows – top movable

e. Handle for right hand

f. Handle for left hand

g. Wind chest

h. Perforated zinc screen and riffles

i. Flanges keeping zinc screen in position

Accompanying Report on the Clermont Goldfield. By B. Dunstan. 1902.

GEOLOGICAL SURVEY OF QUEENSLAND

"The Bismarck Reef

"Lies ten chains north of the Somersetshire Reef. It bears W. 20 degrees N., and underlies 30 degrees to the south. It averages from one foot to one foot six inches. The schist is dipping south-west. Gold was visible in much of the quartz. No returns of crushings were obtainable.

"In concluding this description of the gold-bearing reefs on which any work has been done, I must again point out that the depth to which these reefs have been tried exceeds in no case 150 or 160 feet, and only in a few cases has this depth been reached. The returns of the crushings, too, that have been kept do not give a fair account of their average yield of gold, for the returns of the earlier and best crushings are lost. I certainly am of opinion that some of them will be found payable at deeper levels."—(*l.c.*: page 7.)

Palm Tree Reef.

This reef is on the divide between McDonald's Flat and Copperfield, the position of which is shown on Map 2. Mr. Rands in 1886 reported (*l.c.*: page 6) that:—

"The reef lies 200 yards north of the eastern workings of the Crown Reef. It bears W. 10 degrees N., and underlies 27 degrees south. The depth of the shaft is 105 feet. The roof has been 'stoped' away for some distance down to the forty-feet level. At eighty feet a level of 150 feet in length has been driven, throughout which the reef averages from two to three feet in width of quartz; that on the foot-wall, for about sixteen inches in width, in the gold-bearing quartz. Two crushings from this depth—one of ninety tons and one of seventy tons—yielded seventeen pennyweights of gold per ton. At 105 feet the quartz is beginning to contain a mundic of iron pyrites and galena. The last crushings were:—

Year.	Tons.	Gold per ton. Dwt. grs.
1882	92	17 0
1885	24	16 0
1886	210	6 5

"Down to ninety feet the country is sandy micaceous schist; at that depth a black hornblendic schist occurs."

Since that time the shaft has been sunk deeper, but with what result is not known. There are several tons of stone in a paddock on the surface which were brought up to crush, but assays indicated only about three pennyweights of gold to the ton, and consequently the stone was not taken away for treatment.

On the surface of the mullock heap, chloritic schist with pyrites was observed, and also a white quartz with a carbonate of iron in the joints. The surface workings also indicate that two almost parallel reefs exist, or else one has been very much faulted and appears as two.

The Crown Reef.

This reef is close to the Palm Tree Reef, and apparently is an extension of one of the two reefs above referred to. Concerning this, Mr. Rands reported (*l. c.*: page 6) that:—

"The reef is situated a mile and a-half to the east of the Star of Hope. The reef runs W. 30 degrees N.; underlie, 10 degrees S. 30 degrees W. A shaft has been sunk, cutting the reef at sixty-four feet, at which depth it is a milky-white quartz containing a little galena and pyrites, and is from six inches to two feet six inches in width. Most of the gold is in casing of rubbly and honeycombed quartz, though the white quartz contains from six to eight pennyweights per ton. Nearer the surface, patches of from 100 to 200 ounces of gold were found. The country is a foliated micaceous schist, very much crumpled.

"The latest crushings were—one of thirty-one tons, which gave seven pennyweights twelve grains of gold per ton; and one of nineteen tons, giving one ounce seven pennyweights five grains per ton."

The mine has been abandoned for some years, although about the gullies and ridges close by a few miners are treating the surface soil by dry-blowers.

Dingo Reef.

This is a reef close to the Palm Tree Surface Lead, on the divide between the heads of the Busy Bee Gully and the gullies falling northerly to the Ironstone Lead. The prospecting work comprises a few trenches, and, although there is evidence on the surface outcrop that the reef is not a small one, the results must have been unsatisfactory. Recent assays of the stone from all the outcrops along the line of the reef yielded at the rate of a little over three pennyweights of gold to the ton.

Homeward Bound Reef.

This reef is situated about three-quarters of a mile north-east of Copperfield, about a quarter of a mile east of the Clermont-Copperfield Road. The reef could not be examined, as the mine is abandoned. At the time of Mr. Rands' inspection the mine was working, and he reported (*l.c.*: page 5) as follows:—

"It runs W. 40 degrees N., and underlies 30 degrees to the south-west. It has been traced along the surface for over 300 yards. The country rock consists of various schists—soft micaceous schists, and hard fine-grained fissile sandy schists passing into sandstones. Towards the north-west at the surface it is a big reef, but only the quartz on the foot-wall carried gold.

"Of the old shafts the only one I could descend was the shaft (A) which cuts the reef at seventy-five feet. In the ninety-feet level the foot-wall is of a hard sandy schist, and the hanging-wall a softer micaceous schist. In this level small east and west slides, dipping south, displace the reef about its own width. Following this level to the north-west, the reef has pinched to an inch or two in thickness; it

widens out again below, where a small winze was put down on a shoot of gold. Down to this level it was fairly rich and paid well. The average width of the gold-bearing quartz is here one foot to one foot six inches, the width of the whole reef being about two feet to three feet. The crushings, from this depth to the surface, varied between ten pennyweights and three ounces of gold per ton, the average being from twenty to twenty-five pennyweights per ton. But little of this reef has been taken out from this shaft, the chief workings lying to the north-west. The reef to this level was an ordinary quartz reef. (See Plate 1.)

"I went down the trial shaft (B—the shaft already alluded to) and examined the mullocky 'formation' cut at 230 feet. This consisted of a mass of broken-up schists, with angular pieces of quartz, between two walls about six feet apart. It is probably a slide. The hanging-wall is of foliated micaceous schists, smooth and striated; the foot-wall is not so well defined. The quartz in the mullock is full of mundic. The mullock itself contains some gold; samples assayed went from three pennyweights to five pennyweights of gold per ton."

"It is evident, on referring to the transverse section, that this could scarcely be the orginal reef, for if so it would have been nearly vertical just in that part where it had not been followed on, whereas elsewhere it underlies at an angle of 30 degrees at least. Again, the great change in character between the original reef and that met with at 230 feet points to the same conclusion.

"The records of the earlier and best crushing are lost; the last ones were from the ninety-feet level, and from the winze they were:—

Year.	Tons Crushed.	Yield. Oz. dwt.	Gold per ton. Oz. dwt. grs.
1882	38	48 5	1 5 14
1883	28	20 0	0 14 17

A footnote by Mr. Rands to this states that:—

"Since writing this Report I hear from Dr. Cranstone, one of the shareholders of the mine, that the drive cut (what in all probability is the Homeward Bound Reef) within a few feet of the shaft in a place where it had pinched greatly, and that it passed through the shaft, as I expected, at 140 feet. A drive put in at a lower level to the south has also cut the reef."

For purposes of reference, the plan accompanying that Report is reproduced on Plate 1 in the present one.

Lincoln Leaders.

The Lincoln Leaders are situated on the western side of the Clermont-Copperfield Road, and on the same ridge as the Homeward Bound Reef, from which it is less than half-a-mile away. There are about a dozen leaders carrying gold, most of which are trending east and west, and which other leaders irregularly cross. The leaders are usually mere threads of quartz, ironstone, and limestone, but occasionally these threads are found to be very richly impregnated with gold.

The country rock is a talcose slate containing quartz leaders along its bedding planes. Sometimes the quartz leaders, or "country quartz," become enlarged to irregular masses, but whether in small or large masses they do not contain more than traces of gold.

The workings do not extend below forty feet from the surface, but excavations have been made all over the surface in the search for other rich leaders. It is very probable that other such leaders exist, but from the shafts and excavations there is little to guide one as to how or where to search for them. It is the opinion of some that they are a continuation of the Homeward Bound Reef, which might be so, but from the notes obtained by Mr. Rands in 1886 and quoted above, and from what has been recently observed by the writer, there are certainly not many features common to both to suggest their being connected with one another.

The Star of Hope Reef.

The position of this is about half-a-mile to the north of the Peak Downs Copper Mine and close to the township of Copperfield, on the western side of the Clermont-Copperfield Road. It is not shown on the accompanying large scale map, but its approximate position can be seen on Map 2. Concerning this reef, Mr. Rands in 1886 reported (*l.c.*: page 5) that:—

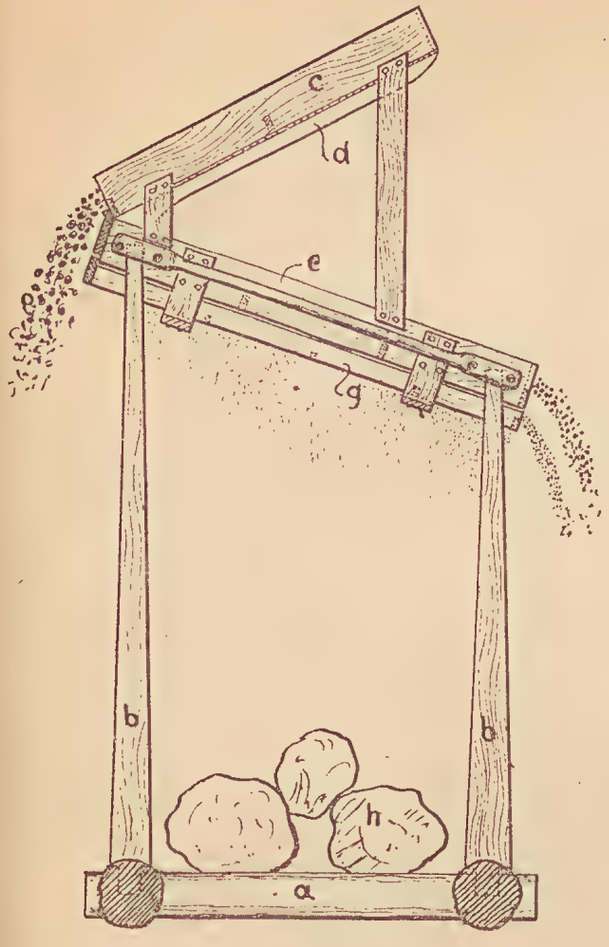
"It bears E. 5 degrees N., and is perpendicular. Country micaceous and hornblende schists, which dip at low angles to the south. These schists are much contorted and cracked at right angles to the direction of pressure.

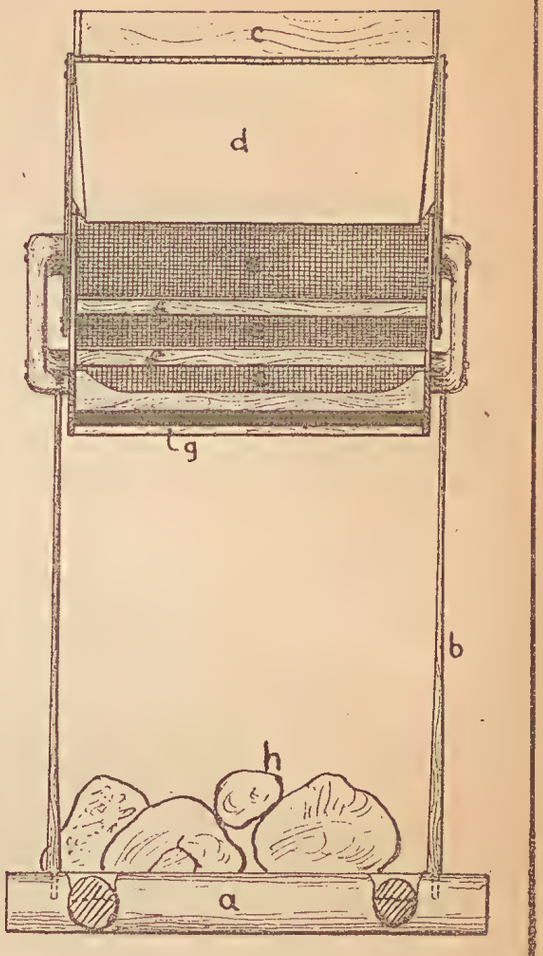
"Down to the 110-feet level the Star of Hope is an ordinary quartz reef, a little honeycombed, averaging about eighteen inches to two feet in width. It has been stoped away for some little distance to that depth. From the surface to the seventy-feet level the crushings gave an average yield of one ounce of gold per ton; from the seventy-feet to the 110-feet the average was about twelve pennyweights per ton.

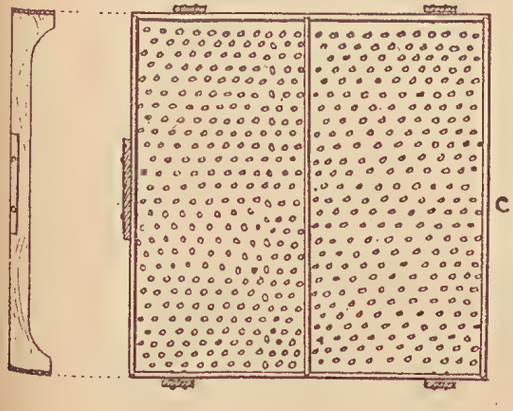
"Below the 110-feet level the quartz contains a large amount of mundic, consisting of iron and arsenical pyrites; assays of this quartz, I am informed, gave ten pennyweights of gold per ton.

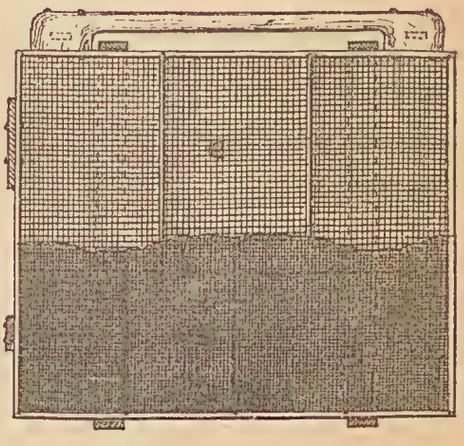
"At 150 feet in depth the country changes from a silvery-looking micaceous schist to a black hornblendic schist. Toward the western end of this claim (the P.C.) the reef also changes with the country, and from 150 to 180 feet in depth is of a mullocky nature and contains much mundic and quartz. I could not examine this part. A slide occurs in this claim, dipping 40 degrees north-west and extending from the deepest shaft right to the surface, which throws the reef about eight feet to the north on the western side. This reef has been traced for nearly three miles in a westerly direction, and throughout this length claims have been worked.

DRY JIGGERS









Scale 0 1 2 Ft.

Reference

a. Bed frame

b. Spring battens

c. Hopper (perforated)

d. Apron

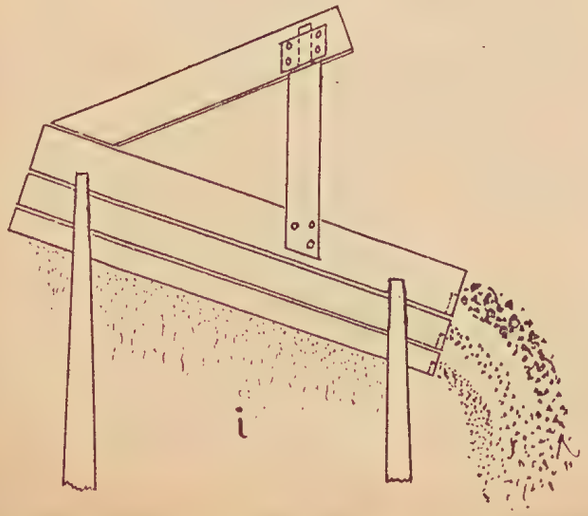
e. Top screen

f. Riffles on top screen

g. Bottom screen

h. Stones on bed frame

i. A jigger with one-end delivery



Accompanying Report on the Clermont Goldfield by B. Dunstan. 1902.

"The returns of the later crushings from this claim show as follows :—

Year.	Tons Crushed.	Yield. Oz. dwt. grs.	Gold per Ton. Oz. dwt. grs.	Depth. Feet.
1881 ...	496 ...	523 8 0 ...	1 1 0 ...	40 to 90
1882 ...	754 ...	611 3 12 ...	0 15 17 ...	90 to 100
1883 ...	134 ...	93 1 0 ...	0 14 0 ...	100 to 110
1884 ...	58 ...	35 7 0 ...	0 12 12 ...	112
1885 ...	67 ...	30 4 0 ...	0 9 6 ...	110."

In 1894 Dr. Jack inspected this reef, and in his Progress Report (*l.c.*: page 14) he refers to the Star of Hope Mine as follows :—

"At the east end the reef is eight feet wide, as seen in some open workings made since Mr. Rands' visit. Three hundred tons of red rubble are said to have yielded gold at the rate of nine pennyweights per load. On the prolongation of this reef on the east side of the road from Copperfield to Clermont there is some open work, from which ninety tons of stone are said to have been crushed for a yield of nineteen pennyweights of gold per ton."

Recently parcels of stone from this mine have been treated by one of the local batteries, and have yielded between four and five pennyweights of gold to the ton, but which from bulk assays were said to contain over an ounce to the ton, the men who are working the mine on tribute asserting that to get five pennyweights of gold by battery treatment the stone should indicate twenty-five pennyweights by bulk assay. The gold is in a fine state of division, and the treatment of the tailings containing the residue of the gold has not been successful so far.

From an examination made of the workings of this mine it can be stated that the reef has probably a long life before it, as there is every indication of permanence, and in the method of getting out the stone there is very little to be desired. Its success, however, will depend on the proper treatment of the stone. The miners are of opinion that when the size of the reef is considered, which from all the exposed workings is shown to average about two feet, returns of half-an-ounce of gold will more than pay all expenses. The stone can be raised for 12s. per ton.

The following returns from the Star of Hope Mine have been supplied by Mr. Howard Smith, of Copperfield, and will show the yields of stone taken from various parts of the mine, and also the width of the reef at these places :—

STAR OF HOPE MINE RETURNS.

Depth from Surface in Feet.	Width of Reef in Inches.	Tons of Stone Crushed.	Gross Yield.	Average per Ton.
Feet.	Inches.	Tons.	Oz. dwt. grs.	Oz. dwt. grs.
12	20	28	14 0 0	0 10 0
12	15	34	23 16 0	0 14 0
20	19	40	35 4 0	0 17 0
20	20	28	7 0 0	0 5 0
38	20	30	7 10 0	0 5 0
40	18	54	34 5 0	0 12 15
80	18	80	66 6 0	0 16 9
85	24	57	51 4 0	0 17 23
90	23	24	27 12 0	1 3 0
100	24	85	63 15 0	0 15 0
100	24	96	76 16 0	0 16 0
100	27	54	68 18 0	1 5 12
100	26	50	32 17 0	0 13 3
100	26	52	29 2 0	0 11 4
106	20	39	32 8 0	0 16 14
106	20	31	27 13 0	0 17 10
106	30	80	48 0 0	0 12 0
106	30	100	70 19 0	0 14 4
109	24	12	9 12 0	0 16 0
112	20	56	35 7 0	0 12 12
...	...	Tons .. 1,030	Oz... 762 4 0	Average...0 14 19$\frac{2}{10}$

Note.—This stone was crushed by an ordinary battery without any special appliances, and the return was little if any more than one-third the assay value. (H.S., 5-8-01.)

Other Mines on the Star of Hope Line of Reef.

Eldorado ("*Golden Gate*," "*Day Dawn*").—"*The Eldorado*, a quarter of a mile west of the Star of Hope P.C. The early crushings were good; the last, of twelve tons, went only 7 dwt. 12 gr. of gold per ton."—(*W.H.R.*, *l.c.*: page 5.)

Dolly Dixon ("*All Nations*," "*Never Despair*").—Concerning the "Never Despair," Mr. Rands gives (*l.c.*: page 5) the following crushings :—

Year.	Tons Crushed.		Gold per ton. Dwt. grs.	Depth. Feet.
1882 ...	22	averaged	11 12 ...	50
1883 ...	112	„	5 6 ...	20
1884 ...	48	„	7 15 ...	60

Dr. Jack refers in his 1894 Report (*l.c.*: page 14) to another crushing of forty or fifty tons during the year 1884 yielding thirteen pennyweights of gold to the ton.

This reef has been divided up into a number of claims at various times, and it is difficult to tell the old mines by the new names. The Dolly Nixon lies to the west of the Star of Hope, and has been working until quite recently. The reef in this mine has many features in common with the portion in the Star of Hope, although the yields are said to be poorer.

The impression on the field is that, judging from all the old returns of past years, the richer end of the reef is towards the east, and the further west it extends the poorer it becomes.

Sons of Freedom.—"Shaft, one hundred and ten feet deep. Latest crushings were:—

Year.	Tons Crushed.	Yielded Oz.	dwt.	grs.	Gold per ton. Dwt.	grs.	Depth. Feet.
1882	144	72	18	15	10	4	60
1883	268	80	8	0	6	0	100"

—(*W.H.R., l.c.*: page 6.)

The Caledonia.—"Shaft, 90 feet. The only crushing of which record has been kept was twenty-four tons, which yielded six pennyweights per ton."—(*W.H.R., l.c.*: page 6.)

Ida Crompton.—"The earlier crushings averaged up to ten pennyweights per ton. The last, in 1884, of fifty-four tons, yielded only three pennyweights twelve grains of gold per ton."—(*W.H.R., l.c.*: page 6.)

Star of the East Reef.

"This reef was called Star of Hope No. 1. It runs east and west, and is perpendicular. It is situated about two and a-half chains north of the eastern end of the Star of Hope Reef. It is a quartz reef in similar country to the Star of Hope. But little has been done on it. The latest crushings are:—

Year.	Tons crushed.	Yielded. Oz.	dwt.	grs.	Gold per ton. Dwt.	grs.
1882	50	31	5	0	12	12
1883	204	94	8	10	9	6"

—(*W.H.R., l.c.*: page 6.)

The Welcome Reef.

"The reef lies five chains north of the Star of the East. It bears east and west, and underlies 20 degrees to the south. The schists dip 30 degrees south-south-west. It is a white milky quartz reef, averaging ten inches to one foot in width. A shaft, sixty feet deep, has been sunk on it. Down to fifty feet it was very rich, averaging throughout three to four ounces of gold per ton. The last crushing of twelve and a-half tons gave sixteen pennyweights of gold per ton."—(*W.H.R., l.c.*: page 6.)

The Peak Downs Copper Lode.

Note.—This lode has been a source of gold as well as of copper, but it has recently been inspected by Mr. Rands, the details of which are given in his Progress Report for 1899—p. 2.

THE FIRST BATTERY RETURNS AT CLERMONT.

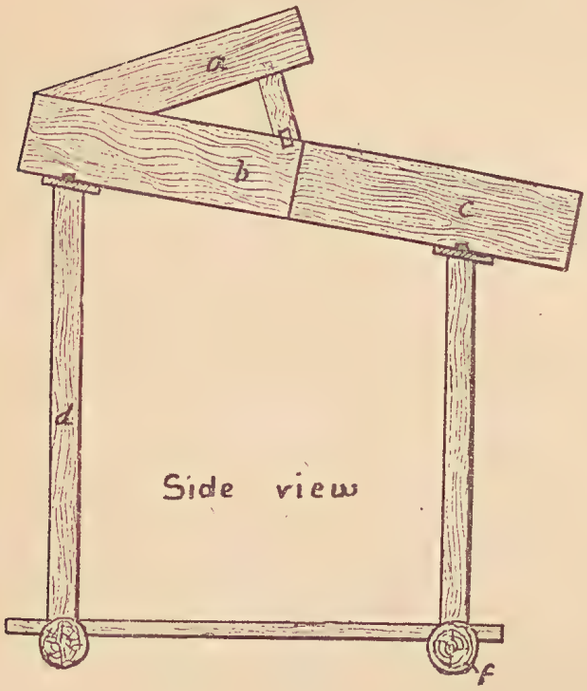
The following table, compiled by Mr. C. Appleton, has been extracted from an old copy of the *Peak Downs Telegram*, and will show the returns from some of the reefs which were worked years ago, many of which have been referred to in the preceding pages:—

Battery Returns.

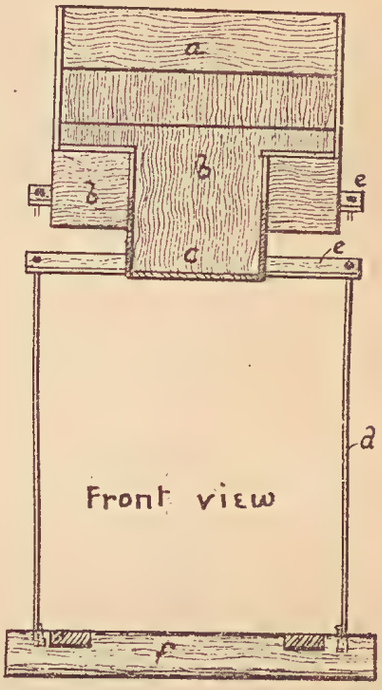
Date.	Name and Locality of Reef.	Quantity.	Average.
		Tons.	Oz. dwt. grs.
1869.			
24 September	Mac's Reef, McDonald's Flat	50	0 17 14
1 October	Doctor's Reef, McDonald's Flat	53	1 17 1
8 „	Homeward Bound, Copperfield	64	1 11 17
1 November	Reimers' Reef, McDonald's Flat	56	0 9 (?)
11 „	Star of Hope, Copperfield	112	0 4 9
16 „	Star of Hope, Nos. 5 and 6, Copperfield	55	0 2 0
18 „	Victoria, McDonald's Flat	40	0 6 1
20 „	Star of Hope, No. 2, Copperfield	10	0 12 4
1870.			
13 April	Homeward Bound, Copperfield	64	0 18 13½
3 May	Star of Hope, No. 2, Copperfield	51	0 14 4
17 „	Doctor's Reef, McDonald's Flat	31	0 12 16
19 „	German Reef, McDonald's Flat	22	0 10 12
22 „	St. Patrick's Reef, McDonald's Flat	36	0 8 0
10 June	Homeward Bound, Copperfield	15	0 4 5
18 „	Homeward Bound, Copperfield	43	0 13 21
13 July	Doctor's Reef, McDonald's Flat	15	2 0 0
16 August	Star of Hope, No. 2, Copperfield	52	1 0 0
25 „	Homeward Bound, Copperfield	54	0 6 0
25 September	German Reef and Star of Hope No. 3, Copperfield	77	0 3 5
4 October	Welcome Reef, Copperfield	32	2 17 13½
8 November	Star of Hope, No. 2, Copperfield	51	1 0 1
10 December	Welcome Reef, Copperfield	65	1 14 19
20 „	Star of Hope, No. 2, Copperfield	63	0 8 0
1871.			
16 February	Star of Hope, No. 2, Copperfield	65	0 11 2
13 March	Welcome Reef, Copperfield	51	1 0 15
21 „	Prospecting Claim	56	0 2 21
6 April	Star of Hope, No. 2, Copperfield	40	0 9 14
26 May	St. Patrick's Reef, McDonald's Flat	51	0 10 1
16 June	Victoria, McDonald's Flat	50	0 6 22
4 September	Victoria, McDonald's Flat	27	1 5 17

WET JIGGERS

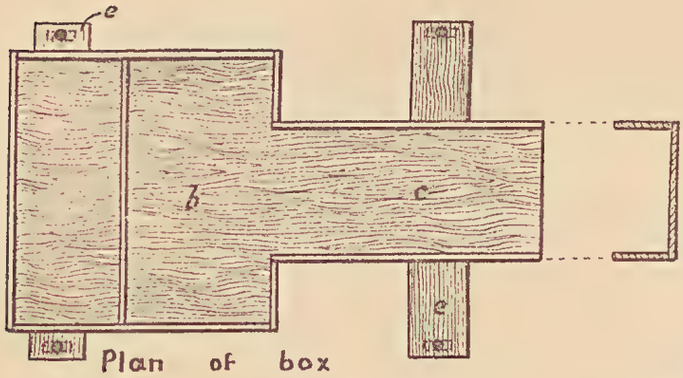
Entirely replacing the cradle in alluvial gold-washing at Clermont.



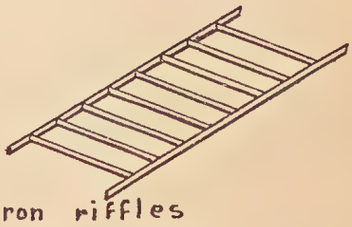
Side view



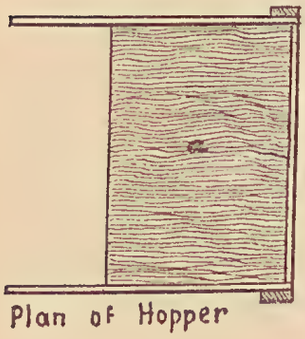
Front view



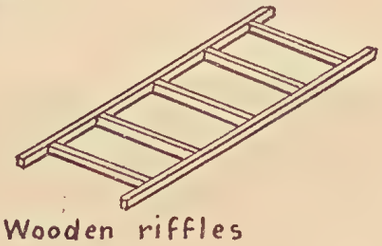
Plan of box



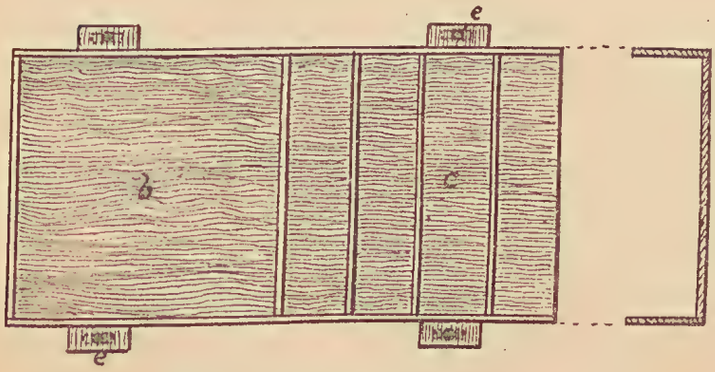
Iron riffles



Plan of Hopper



Wooden riffles



Plan of another form of Box

Reference

a. Hopper
b. Body of jigger
c. Riffle box
d. Spring battens
e. Cross pieces
f. Bed frame

Scale

0 1 2 Ft.

Accompanying Report on the Clermont Goldfield by B Dunstan 1902

DRY-BLOWERS AND OTHER IMPROVEMENTS IN ALLUVIAL GOLD-MINING APPLIANCES.

It is proposed to describe only those machines and other accessories which have proved to be of special importance in alluvial gold-mining on the Clermont field. The ordinary processes of saving alluvial gold being so commonly known, a description of them will not be required.

We have, first, the machines known as *dry-blowers* and *dry-jiggers*, machines which have saved thousands of ounces of alluvial gold since they were introduced, and which in consequence have considerably extended the life of some of the surface leads. Then there is the *wet-jigger*, a simple machine which has entirely replaced the Californian cradle on this goldfield, and which most certainly will replace it in any part of the world it may be introduced, its advantages being so obvious. Another improvement in "whips" for draining water is the *circular whip*, in which the horse travels around a circular track, and the emptying of the bucket is automatic.

At the time when a number of dry-blowers were brought into use on the Western Australian fields for saving gold, one of these machines was brought over by a miner to Clermont. The machine was very cumbersome to move about, very laborious to work, and had several defects in its arrangements for saving the gold, and consequently did not find much favour amongst the Clermont miners. It was known as the "knocker," because it had an eccentric movement, producing an upward blow to the hopper or screen on which the wash is thrown before coming in contact with a blast from a bellows. A photograph of one of these discarded machines at Clermont is shown on Plate 2.

From this machine there were many modifications, all more or less successful in helping to remove objectionable features or else introducing new ideas, until now machines are constructed which are almost perfection. The principles underlying the machines are, first, the separation of the larger pebbles in the wash from the finer portion by a coarse perforated plate; second, the delivery of what passes through this coarse screen to one finely perforated; and, third, the forcing through the fine screen of a blast of air sufficiently strong to remove the earthy particles without also removing the gold.

In all of the machines the coarse perforated plate (or plates) is made of iron, and the material passing through this is thrown off as "hopperings." That which passes through the screen is fed on to a steeply-inclined finely-perforated zinc plate forming the top of the wind-chest of a bellows. By the blast of air the material is blown away from the zinc plates, and riffles are placed horizontally on the top of this to catch the gold. From the number of perforations in the zinc plate a casual observation might lead one to suppose that the gold, as well as the other material, would be blown away, but experience has shown that the gold is usually caught in the first couple of riffles in a box of half-a-dozen or more, and seldom, if ever, near the bottom. If the gold is lost it is due to the earth being damp or clayey, the gold clinging to the earthy particles being blown out.

The three machines to be described are types of Clermont dry-blowers.

Carlson's Dry-Blower.

This machine has been in use longer than any of the others, and all over the goldfield numbers of them are to be seen in operation. A drawing of it is shown on Plate 4, and a photo.-reproduction in Plate 3.

The hopper and hopper screen on top of the machine, and the wind-chest, zinc perforated screen and riffle-box below are all fixed to the long board forming the top of the double bellows, and as the handle attached to the bellows is raised or lowered to make the blast, so the hopper, riffle-box, and wind-chest is rocked from side to side with a see-saw motion, the fulcrum being the block of wood separating the two bellows. The hopper screen and its riffles are not removable, and only require to be looked at occasionally for coarse gold, but the riffle-box, to which is attached the zinc screen, has to be taken out frequently. The riffle-box has two sides tapering towards the front, so that it may be firmly wedged into a number of metal fastenings and set perfectly air-tight on the top of the wind-chest.

In operating the machine the coarse material comes over the front of the hopper, the finer portion being delivered on to the top of the riffle-box, where the see-saw motion and the pulsating blast together causes it either to be blown out or to descend over the riffles.

The residue in the riffle-box is thrown into a prospecting dish, then wind-blown by tossing or by pouring from one dish to another. The heavy particles, too heavy to be thus removed, are taken out by a quick motion of the hand after settling the gold at the bottom of the dish, and the gold is finally cleaned by blowing with the mouth. The task of separating the gold by "dry-washing" seems to require considerable skill, but the miners get accustomed to it, and to them it becomes a simple, rapid, and mechanical operation. With fine gold there is not much loss through want of skill or from carelessness, but generally from the gold adhering to the particles of stone or clay. Further details are shown on Plate 4.

Rankine's Dry-Blower.

In this machine there are two screens to the top of the hopper, one coarser than the other, each provided with riffles. The motion of the hopper and the top screens is not the see-saw one of Carlson's Blower, but is horizontally from side to side, which the inventor claims is a decided improvement. The zinc screen and box is placed above a single bellows, both of which remain stationary during the operation of blowing. From the drawing of the machine on Plate 5, it will be seen that the handle is supported on a rigid iron frame, which acts as the fulcrum, and has one connecting bar attached to the hopper, while another bar extending along the back of the machine connects with the bellows. The hopper is supported on the side next to the handle by a swinging iron frame resting on the fixed iron frame supporting the handle, and on the other side the hopper is kept in position by two flat wooden supports attached to the base. These wooden supports are made very slender, and act as springs to pull

the hopper back to a central position when the handle, by being moved up or down, has forced it to either side. The machine is well constructed, and as only the hopper of the machine has to move, the life of the machine is considerably extended, besides reducing to a minimum its weight and the labour to operate it.

On Plate 3 a photo.-reproduction of one ready for working is shown.

Buhre's Dry-Blower.

Buhre's machine combines the horizontal motion of the hopper and the stationary riffle-box of the Rankine Blower with the double bellows of the Carlson Blower. It has its advocates amongst the miners, some of whom prefer the double blast to the single one. Its construction is shown in the drawing on Plate 6. The bottom board of the double bellows is made the foundation of the machine, while the tops are hinged to the sides of the wind-chest. The handle moves the top of the bellows, which by a rod is connected to one side of the hopper. As the handle is moved, say upwards, the air is drawn into the bellows on that side, and at the same time the connecting-rod forces the hopper to the right (see arrow point in the illustration). Another connecting-rod from the other side of the hopper is attached to the opposite bellows, and as this is depressed a blast is driven up through the zinc screen.

A commendable feature of the machine is the hinges of the two bellows being placed on top instead of at the bottom A difficulty is experienced in keeping the hinges free from an accumulation of dust when they are placed at the bottom, as in both Carlson and Rankine's blowers, and the constant motion has a tendency to squeeze the dust into the crevices between the hinges and their leather covering. If care is not exercised to have the inside of the bellows occasionally cleaned from dust, the woodwork and the leather will either burst or become strained. With Buhre's Blower this objectionable feature is removed.

Notes on the Dry-Blowers.

The perforations in the zinc screen are placed an eighth of an inch apart, and there are about five parallel rows right across the screen just above each riffle. The number of riffles vary from six to eight. The perforations are made with a blunted No. 8 sewing needle, or a bundle of them set in a block.

The riffle-box with the zinc screen on the bottom has to be well fitted, and should not require any packing. Leather may be used to make this airtight, but this soon wears away and requires frequent renewal.

The angle of inclination of the riffle-box in all the machines now used is unalterable, as experience has shown that the working angle varies but slightly.

If it is found necessary to alter the angle, it may be done by slightly tilting the whole of the machine and fixing it in this position by a support under one leg. This is much preferred to the adjustable riffle-box on the top of the wind-chest made partly of leather, an arrangement not so substantial as when made entirely of wood. The less inclined riffle-box will save more fine gold than the steeply inclined box, but it will not allow so much earth to be put through in a given time. If the character of the gold in any deposit is known, the machine can be set accordingly and without any experimental work.

The capacity of the machines described above are very much the same, being about four or five loads a day under nominal conditions. Should the earth be at all damp, this quantity will be diminished, but when dry on a hot day the quantity will be increased. With the assistance of a second man, about eight loads can be treated. If the earth is hard, it is beaten up with a piece of timber shaped for the purpose. Under favourable conditions—the wash perfectly dry and gravelly—many miners prefer the dry-blowing to wet methods.

The machines are not suitable when the earth is clayey, although this difficulty can sometimes be overcome by heating the earth and then powdering it on a flat sheet. Losses of gold are generally due to the presence of this clay, and if a clayey wash once treated be allowed to remain exposed for some time to the weather and treated again, more gold will probably be obtained.

With reference to the blast, some have been of the opinion that a fan would answer the purpose of a bellows. This has been tried repeatedly at Clermont, and has proved an utter failure. The blast evidently requires to be *pulsating*.

The strength of the blast is supposed to have some effect in saving or losing the gold. In one of the Clermont blowers the writer has seen experiments tried, in which it was found impossible to drive the gold off the fine screen even with the strongest blast the machine was capable of producing. What the result would be, however, if the gold was mixed up with earth cannot be stated.

The cost of the locally-made machines varies from £6 10s. to £10, according to the material they are made of, but the great majority of machines cost about £8 10s.

Hopper screens are made of galvanised iron, the perforations being about half-an-inch in diameter, and the centres of the holes less than two inches apart. The holes are commonly made with a punching tool, but it is said the screens last much longer if the holes are bored, as this operation leaves a clean level edge, and to a great extent preventing their becoming choked or burred.

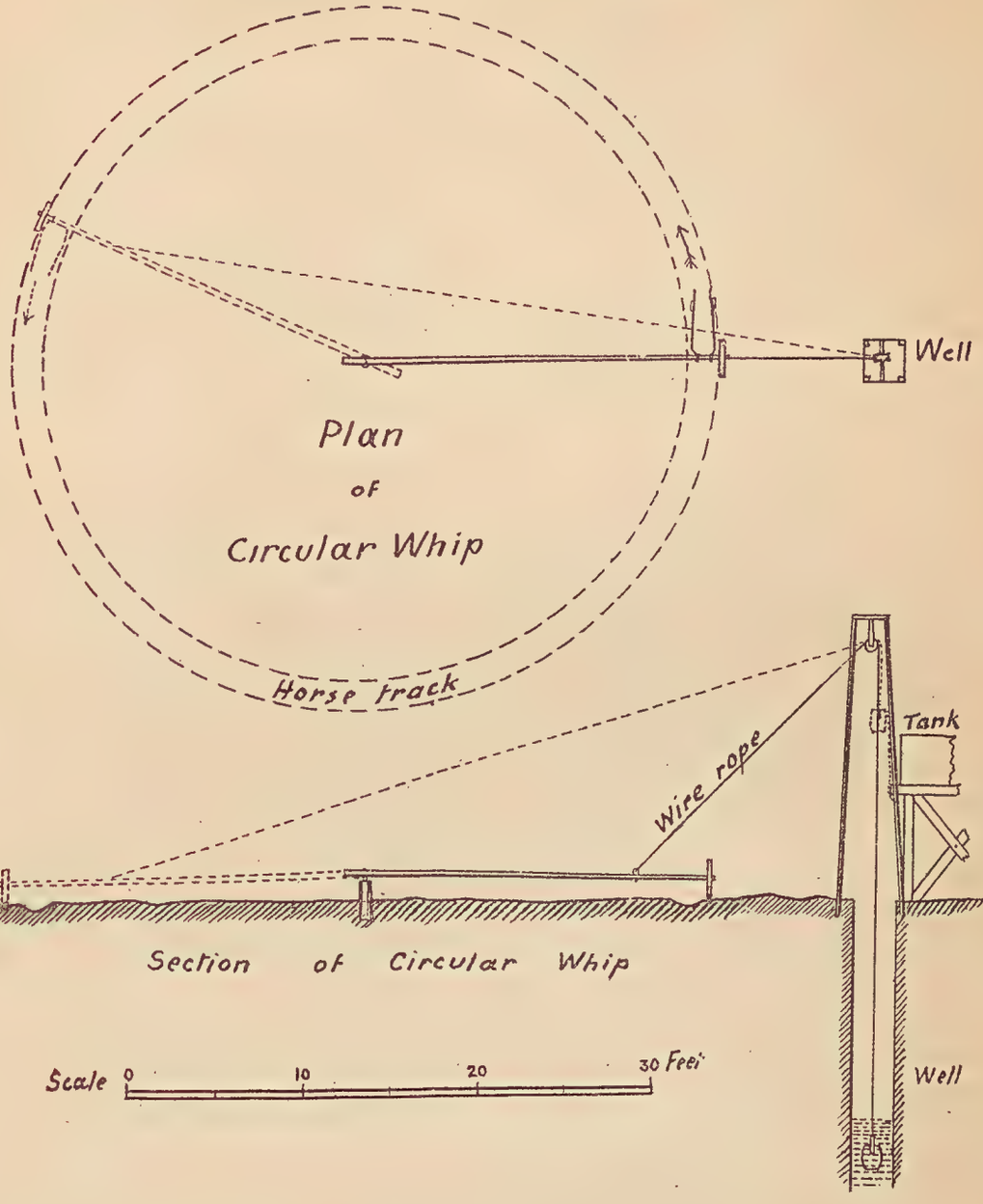
The timber used in the machine should always be well seasoned, otherwise there will be leakages in the bellows and wind-chest in a very short time, and the machine will lose both its rigidity and efficiency.

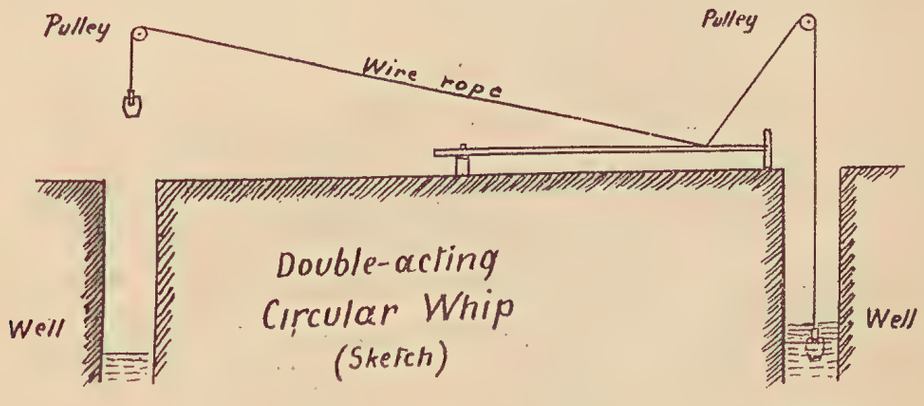
A novel use of the services of a dog in connection with a dry-blower was observed. The fine tailings in front of the riffle-box of the machine require to be removed frequently, and a miner by burying a bone in them at first induced the dog to scratch the tailings away for the sake of the bone. By degrees the dog was taught to remove them without the bone, and now the sound of the machine working is sufficient to bring him in front to perform his work, which is looked upon as his special duty.

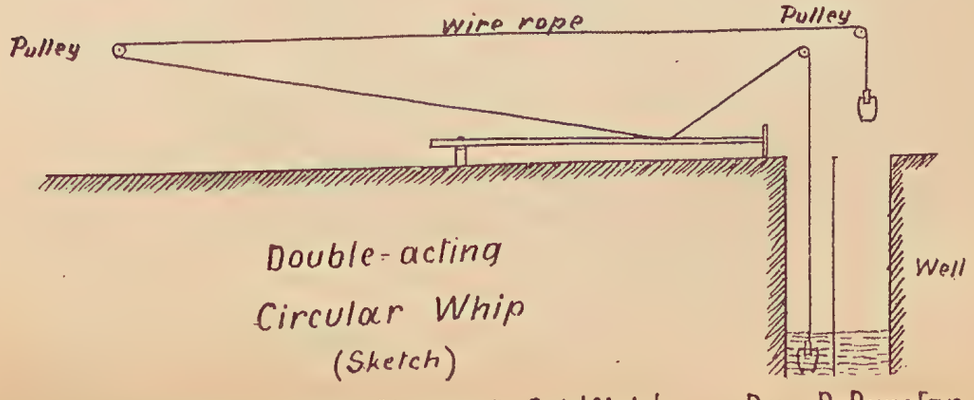
CIRCULAR WHIPS

FOR

PERMANENT SHAFTS & WELLS







Accompanying Report on the Clermont Coldfield. By B. Dunstan. 1902.

Dry-Jiggers.

These machines were introduced as a modification of the dry-blower, the original one, it is said, being made from parts of an old discarded "knocker." The machine as now used consists simply of a number of inclined screens, one above the other, with a varying mesh, and supported on four slender legs. Usually on the top of the screens a perforated hopper is placed to separate the coarse portions of the earth, but sometimes this is dispensed with.

The machine in general use is shown on Plate 7. A perforated hopper with holes of about half-an-inch in diameter is fixed in an inclined position, and all large stones are thrown out at one end. The finer portions travel down an apron (*d*) to the head of the coarse wire screen (*e*), and what will not pass through this is thrown out at the other end. The fine particles passing through this screen fall on to the fine screen (*g*), on which the gold is caught. The fine screen delivers out at the same end as the screen above all the material that will not pass through it, while the very fine dust falls through the screen on to the ground.

The top screen is made with a mesh of about an eighth of an inch in diameter and the bottom one generally one sixteenth of an inch, and any gold finer than this is allowed to pass away.

The jigger is supported on the legs, or springs, by the box carrying the coarse screen (*c*), on the sides of which two handles are fixed, each having two receptacles on the lower side, in which the heads of the legs or springs are set in. The springs in the old machines were made of steel, but experience has shown that wooden ones are much to be preferred; they last longer, are cheaper, and are very easily made. Spotted gum or brigalow are the timbers generally used at Clermont for the purpose. The springs require to be set rigidly in the bed-frame, and should be fitted well and keyed in, otherwise the constant vibration will loosen them. The bed-frame is roughly made, and some heavy stones are placed on it to prevent movement.

The operation of jigging is very simple, but the miners assert that with the same machine and under similar circumstances one man will save gold while another will lose it. One man to each machine is the usual practice, and he begins by throwing a few shovelfuls of earth on to the hopper, and then shaking until all has passed out at the ends or through the fine screen. After repeating this a great number of times the fine screen, with any gold it may have caught, is removed by drawing it out from the two narrow wooden supports going across the bottom of the top box (*e*). After shaking it over a dish or flat sheet it is replaced again, and the jigging is continued. The riffles on the top screen are at intervals inspected for coarse gold.

In having a bottom screen with a sixteenth of an inch mesh, no doubt a loss of gold must take place, but a few experiments with the machine show that even with this mesh the gold does not easily pass through, unless it is fine and shotty. A finer mesh has been used, but it was found that with a reduction in the capacity of the machine there was not a compensating amount of gold saved. As the quantity which can be treated is about double that of a dry-blower, the fine "paint" gold is neglected if there be any coarse gold in the material. Without coarse gold the jiggers are not successful, and dry-blowers are used.

The material to operate upon by a dry-jigger as with the dry-blower should not be moist or clayey. Both of these objectionable features are remedied to some extent by breaking up the earth, as described previously, and spreading it out to dry in the sun. The best stuff to treat is a loose gravel free from clay and quite dry.

A modification of this form of dry-jigger is represented also on Plate 7, and shows the delivery of all the tailings to take place at one end of the machine. The top hopper is not perforated, and delivers all the material on to the top of a set of three boxes. The top box has a perforated sheet-iron screen, the two lower screens being the same as those described above. It is found that the accumulation of tailings at both ends of the machine becomes very inconvenient when working on a face of surface washdirt. This machine in having the delivery at one end does not require the tailings to be shifted in moving the jigger along the face.

Sometimes the jigger is permanently mounted on a wheelbarrow roughly cut out of the forked branch of a tree, and then is very convenient for moving about.

Wet-Jiggers.

The wet-jigger is a further innovation in gold-saving appliances at Clermont, and has produced excellent results since the time it was introduced.

The body of a wet-jigger is constructed on the same principle as that of a Californian cradle, but instead of having rockers on the bottom, it is set up on four wooden springs, similar to a dry-jigger. In working a cradle the movable hopper catches all the coarse material, to remove which the hopper is taken off. In the wet-jigger this coarse material is thrown out automatically, requiring no handling at all. The drawings on Plate 8 show different views of the machine. The body (*b*) is surmounted by an inclined hopper (*a*) useful for feeding, but not indispensable. The body is made of various shapes, the two illustrations being common forms. Riffles are placed in the back part of the body (*b*), and also in the front part (*c*), where it is usual to put a frame of riffles, or a number of riffles fixed in position by wedges.

There is no doubt that the wet-jigger is far superior to the cradle in every respect. In feeding, once the hopper is fixed in position it does not require removing until the clean-up takes place; there is no inconvenience with the tailing, as the end of the box is elevated a couple of feet above the ground; the capacity is greater, it has no rockers or rocker-frame, and the labour in working is reduced to a minimum because of the re-bounding action of the four wooden springs. The proof of its efficiency at Clermont is shown by its adoption all over the field and in its entire replacement of the cradle—not one of the latter machines being now in use.

In transporting the machine from one place to another only the box is removed, as new springs and a bed-frame are so easily constructed. Sometimes even the whole of the machine is left behind, and another one made out of any odd pieces of timber.

Circular Whips.

The circular whip is different to the ordinary type of whip in the horse travelling continuously around a circular track instead of backwards and forwards along a straight one. They are commonly used on the Clermont Gold Field and in the surrounding districts, and are very convenient where water has to be lifted from a permanent level.

The whole arrangement is illustrated on Plates 9 and 10. On Plate 9 the plan shows a pole and circular track for a horse, similar to that of an alluvial "puddling machine." At a certain distance from the pivot in the centre—a distance of little more than half the height of the lift—the hauling-rope is attached to the pole. When the bucket is down the shaft, the free end of the pole near the circular shaft will be closest to the shaft, and, as the horse pulls it around, the bucket rises until the end of the pole is just opposite its former position, or furthest away from the shaft, when it is emptied by an automatic arrangement. At the horse returns to its former position, close to the shaft, the bucket descends to the bottom and becomes filled for another ascent. With an effective method of emptying the bucket the horse travels around the track without stopping.

As well as this form of whip—a single acting one—there are other modifications shown on Plate 9. One of these requires two shafts, two buckets, and two pulleys, while another form has one shaft, two buckets, and three pulleys.

In constructing a horse-track for the single acting whip, advantage should be taken of the first half of the turn, when the bucket is ascending, to make it a down-grade, and the other half of the turn, when the empty bucket is being lowered, an up-grade, thus making the work of the horse more evenly balanced.

At the free end of the pole a wheel is attached, for which an ordinary dray-wheel is very suitable. This is necessary to counterbalance the weight of the bucket of water and also to allow of a fine adjustment of the mechanism for emptying the bucket at the point of delivery. The wheel may, however, be dispensed with by having a circle of saplings, end to end, constructed just inside the horse-track and about two feet high, on which the free end of the pole slides as it is being drawn around. In this case the free end of the pole has to be weighted to counterbalance the bucket.

For emptying the bucket the automatic arrangement shown on Plate 10 is adopted. The handle of the bucket, either of wood or iron, is made to travel on two guides set in the shaft, and to the lip of the bucket a chain is attached, the loop at the other end of which runs loose on a wire rope. The wire rope on the top is fixed close to the receptacle to receive the water from the bucket, and at the bottom is fastened to a frame sunk below the level of the water in the shaft. As the bucket descends, the loop at the end of the chain travels down the wire rope, and as the bucket rises the loop catches against a block on the wire rope and draws the chain tight and prevents the lip of the bucket from rising any higher. The hauling is continued for a few inches more, and the other portion of the bucket being pulled further up is tilted to the side where the chain is attached, and so emptied. This will be more clearly understood by referring to the figures on Plate 10.

By another arrangement the chain is dispensed with and a frame of wood substituted. The frame is fixed above the tank, and an arm projects out sufficiently to catch the lip of the bucket as it rises. This is also shown on Plate 10 (Fig. 9). Its adjustment is not so simple as that of the chain, but the wire rope which is necessary with the chain arrangement is dispensed with.

Wire ropes are sometimes used instead of the wooden guides, but the advantage of one over the other is not apparent. If the guides are of timber, perhaps the working is not so smooth as with wire ropes, but they have the merit of cheapness. The writer saw a wire rope suitable for the purpose, however, made from two lengths of a fencing wire. The two strands were separately fastened to the spokes of a cart-wheel, which was arranged to rotate vertically on a temporary but strongly fixed axle. The other ends of the wire were together fastened to a heavy log, and the cart-wheel was revolved. By the exertions of a couple of men on the wheel the wires were twisted to the extent required, the log being dragged up as the twisting of the wires made them shorter.

In fastening the wires to the bottom of a shaft a frame is made specially for the purpose, and having no connection with the other timbers at the bottom of the shaft. It is lowered into position after the wires have been fixed to it, and is forced down and kept in its place with the ends of four or six long battens, the other ends of which are nailed to the sides of the shaft several feet above the water-level. Should it be desired to remove the appliances in case of flood, these battens can be rapidly taken off, and the frame and the wires hauled up to the surface. The drawing on Plate 10 will show other details of the arrangement of this automatic-tipping bucket.

Note on Miners' Picks.

It may be worth mentioning, for the benefit of other than Clermont alluvial miners, that single-headed picks are only occasionally used on the Clermont field. Some years ago they were commonly used, but when a number of coal-miners from the Blair Athol coal mines became gold-miners they introduced the colliers' picks, which are now used all over the goldfield. Of course in some ground the single-headed pick is very convenient, but wherever they can be replaced by the other form the miners are not slow to make the change. As used at Clermont the colliers' picks are entirely made of steel; they are cheap, easily tempered, and can be worn down close to the "eye." When too short they can be worked up to form the points of other picks, or cut in half and used as gads. The eye is of regulation size, and one handle, iron-cased at the end, can be used for a number of heads. With these picks it is usual to have a small sledge-hammer at the face of the workings.

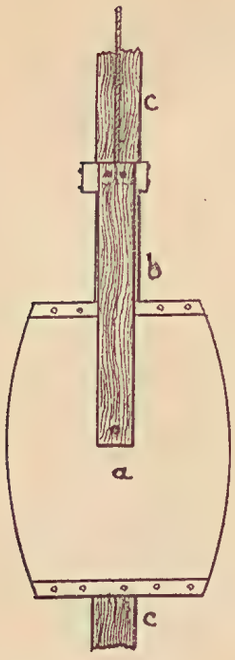
DREDGING OPERATIONS.

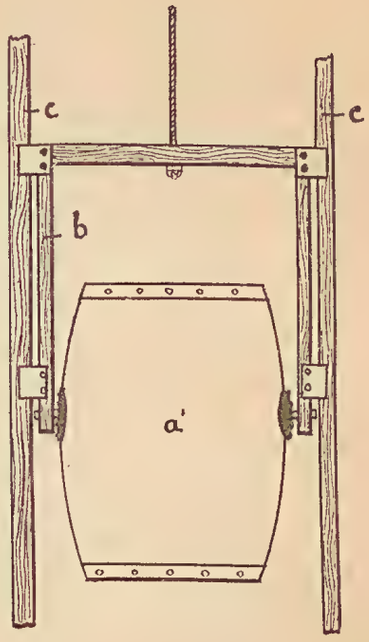
Dredging for gold is a new development in mining practice at Clermont, and was started under circumstances which at the time were considered most favourable. At the commencement there were many obstacles and difficulties encountered in getting the dredge into working order, but these have been overcome.

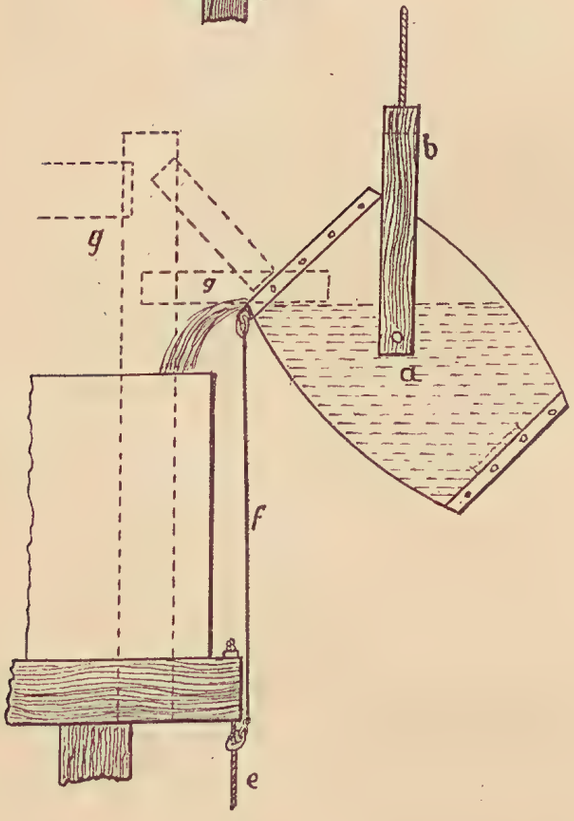
AUTOMATIC TIPPING BUCKET

FOR

CIRCULAR WHIPS







Reference

a. Bucket

b. Frame holding bucket

c. Guides

d. Tank

e. Guide rope

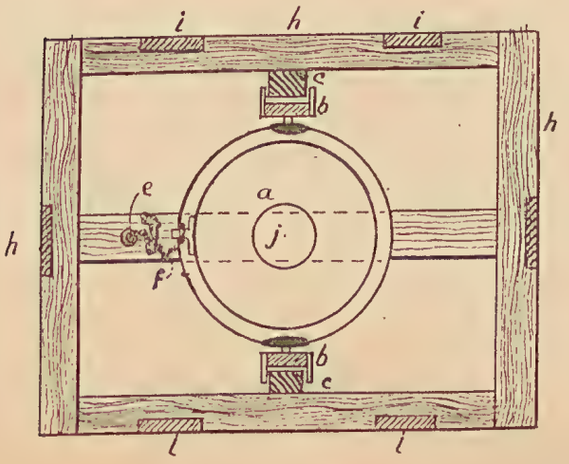
f. Tipping chain

g. Another method of tipping

h. Frame at bottom of shaft

i. Ballens for holding down frame

j. Valve



The initial results of the working of the dredge did not prove satisfactory, as the yield of gold was very poor, but it was thought that better returns would ultimately be obtained, an anticipation, however, that was not realised. It is now supposed, after due consideration of all the features which might have some bearing on the question, that better results will be obtained when the dredge is able to work further up the stream, where it is known that gullies which fall into the creek were once very rich in alluvial gold.

It must be remembered that the whole of the country drained by Sandy Creek and its branches cannot be considered mountainous, and the absence of any great fall from the heads of the streams may be sufficient to prevent a concentration of gold in the main channel where the dredge is operating. With a slight fall and plenty of water, probably the fine gold would not settle until brought into the main channel, while the coarse gold would have been deposited in the smaller channels. If this be so, the conditions of dredging will require to take into account the possibility of this fine gold escaping from the dredge sluices by a repetition of the conditions when it was carried away from the gullies and small watercourses higher up to settle in the more gently flowing stream in the main channel.

A drawing of the Clermont dredge has been prepared from a rough tracing kindly supplied by Mr. James, the dredge master, and is shown on the accompanying plan. Since the drawing was prepared, an elevator has been added to the dredge to deliver the tailings further astern, and thus allow the dredge more freedom in shallow water.

NOTES ON BORING OPERATIONS.

On the accompanying large scale maps the position is shown of a number of bores which have been sunk on the blacksoil flat between Deep Creek Lead and the Wild Cat Lead. They were sunk by the Clermont Prospecting Association with a Government hand-boring plant, a drawing of which has been previously published.* The object of the boring was to test the ground between the above two leads, as so many opinions had been expressed to the effect that the black soil had covered over leads possibly as rich as the two abovementioned leads proved to be.

After boring across the flat and obtaining a little washdirt and a few colours of gold, operations were suspended, as the results did not show that any defined lead existed. From the information obtained recently a diagrammatic section along the line of bores has been constructed, from which their surface level and their depth, compared to the Deep Wet Shaft on the Wild Cat Lead, has been determined. From this section, which it has not been necessary to reproduce, it appears that the bottom of No. 11 bore (see Map 2) is the highest point between the two leads, and from this bore the surface of the slate formation below the black soil undulates more or less, but gradually becomes deeper, both to the north and south. Depressions have been proved to exist from the varying depths of the bores, and very probably other depressions occur which there is no knowledge of, as the distance between some of the bores is sufficient to take in half-a-dozen such leads as the Wild Cat.

A comparison of the levels at which the water is met with in the prospecting shafts sunk to the east of the Deep Creek Lead, and in the deep wet shaft at the end of the Wild Cat Lead, shows that very little difference exists between them, but, nevertheless, there cannot be a direct connection with one another because of the rising slate formation between them. If there be a connection at all it must be around this slate ridge, and further east than the line of bores.

The presence of this slate below the black soil further suggests that a low spur of it connects with other outcrops of slate to the west or south-west. To the south-west the connection would be towards Red Hill or Bald Hill, and to the west it would be in the direction of the Busy Bee Lead and the head of the Wild Cat Lead.

Regarding the Bald Hill Lead, its general features and surroundings suggest the possibility of the Bald Hill Lead continuing across Deep Creek like the Deep Creek Lead itself, that it has been covered by a basalt flow, and that the connection has been broken by the more recent cutting out of the channel of Deep Creek between the slate and the black soil.

By means of the contour lines on Map 2 the altitude of this covered slate formation can be compared to the slate in other localities. It is considerably below the height of the ridge on which the Clermont Surface Lead and Prince of Wales Reef are situated, and it is lower than any of the spurs leading off from this ridge and from those at the head of the Wild Cat Lead. Quite probably it is the lower ends of some spurs of slate formation which have been submerged below deposits of sand and gravel, and afterwards by a flow of basalt, which has since been decomposed.

RECORD OF BORES.

Between Deep Creek Lead and Wild Cat Lead.

(Supplied by Mr. C. Young, Manager of the Boring Plant.)

The positions of the following bores are shown on Map 2:—

Bore No. 1.

	Thickness. Feet.	Depth. Feet.
Red soil and gravel	3	3
Loose quartz gravel	6	9
Cemented quartz	12	21
Clay pug, "slippery back"	30	51
Fireclay	47	98
Clay pug	2	100
Quartz "wash," no colours of gold	4	104
Hard blue slates	4	108

* Progress Report for the year 1900. B.D. By Auth. Bris. 1901. G.S.Q. 159. Plate 4.

RECORD OF BORES—*continued.*

Bore No. 2.

	Thickness. Feet.		Depth. Feet.
Black loam and clay	4	...	4
Quartz gravel	10	...	14
Basalt	36	...	50
Decomposed basalt with quartz pebbles	7	...	57
Quartz boulders	11	...	68
Quartz "wash," rather clayey, no colours of gold...	7	...	75
Slate	3	...	78

Bore No. 3.

Black soil and clay	3	...	3
Gravelly quartz	4	...	7
Clay with fine gravel	9	...	16
Quartz boulders	3	...	19
Gravelly clay	6	...	25
Decomposed basalt with quartz boulders and "clinkers" of magnesite	2	...	54
Gravelly sediment	3	...	57
Sediment with quartz boulders	8	...	65
Ironstone and quartz "wash" with colours of gold...	7	...	72
Soft slate	5	...	77

Bore No. 4.

Black loam	1	...	7
Black clay	6	...	22
Sediment with quartz boulders and "clinkers" ...	15	...	54
Decomposed basalt with occasional quartz-boulders and "clinkers"	32	...	61
Sediment with quartz boulders	7	...	70
Ironstone and quartz wash, no gold	9	...	
Clay slate, very puggy	4	...	74
Soft slate	1	...	75

Bore No. 5.

Black soil	1	...	1
Black clay	8	...	9
Decomposed basalt with quartz gravel and boulders	32	...	41
Cemented sand	1	...	42
Decomposed basalt with quartz boulders and "clinkers"	13	...	55
Fireclay	3	...	58
Decomposed basalt with quartz gravel	4	...	62
Decomposed slate	6	...	68
Slate	2	...	70

Bore No. 6.

Black clay	4	...	4
Decomposed basalt with quartz boulders and "clinkers" (magnesite)	39	...	43
Fireclay	2	...	45
Gravelly "wash," no gold	1	...	46
Clay slate	4	...	50

Bore No. 7.

Red loam	1	...	1
Cemented gravel	5	...	6
Decomposed basalt with occasional seams of cemented sand	57	...	63
Gravelly basalt wash, no gold	1	...	64
Clay slate	6	...	70

Bore No. 8.

Red soil	1	...	1
Cemented gravel	4	...	5
Cemented gravel with seams of sandstone	14	...	19
Decomposed basalt with quartz boulders and clinkers	46	...	65
Quartz "headings" and "wash"	9	...	74
Soft silvery slate	2	...	76

RECORD OF BORES—*continued.*

Bore No. 9.

	Thickness. Feet.	Depth. Feet.
Red soil	1	1
Cemented gravel with seams of hard sandstone	18	19
Decomposed basalt with occasional quartz boulders and clinkers	29	48
Fireclay	4	52
Cemented sand	2	54
Soft silvery slate	6	60

Bore No. 10.

Red soil	1	1
Black clay	2	3
Red clay	12	15
Decomposed basalt with bands of fine gravel	22	37
Seams of clay with fine gravel	22	59
Cemented ironstone	1	60
Gravelly "wash," no colours of gold	1	61
Slate	2	63

Bore No 11.

Red soil	1	1
Cemented gravel	6	7
Decomposed basalt with occasional quartz boulders and clinkers	41	48
Cemented sand with clinkers (magnesite)	2	50
Slate	3	53

Bore No. 12.

Black soil	1	1
Black clay	6	7
Decomposed basalt with quartz gravel and boulders	13	20
Clay	2	22
Decomposed basalt with quartz boulders and clinkers	25	47
Ironstone "wash," no gold	2	49
Slate	5	54

Bore No. 13.

Red soil	1	1
Cemented gravel	1	2
Hard clay	4	6
Decomposed basalt with occasional quartz boulders	45	51
Fireclay	7	58
Ironstone "wash," no gold	1	59
Slate	4	63

Bore No. 14.

Clay, with gravel	14	14
Clay	6	20
Cemented sand	3	23
Basalt with quartz boulders	25	48
Cemented sand	3	51
Decomposed basalt with clinkers (magnesite)	8	59
Cemented sand	5	64
Slate	4	68

Bore No. 15.

Black clay	3	3
Black clay with occasional small stone	16	19
Basalt with quartz gravel	6	25
Decomposed basalt with clinkers (magnesite)	17	42
Fireclay with small seams of gravel	12	54
Drifty gravel wash, no gold	2	56
Red clay	12	68
Slate	1	69

Bore No. 16.

Red clay	13	13
Decomposed basalt with quartz and clinkers	20	33
Cemented sand with bands of quartz gravel	12	45
Decomposed basalt	19	64
Clay	6	70
Slate	2	72

RECORD OF BORES—*continued.*

Bore No. 17.

	Thickness. Feet.	Depth. Feet.
Clay	11	11
Decomposed basalt with seams of cemented sand	27	38
Hard cemented sand with bands of quartz gravel	19	57
Decomposed basalt with clinkers (magnesite)	21	78
Quartz and ironstone wash, no gold	2	80
Soft yellow slate	2	82

Bore No. 18.

Black clay	5	5
Gravel	5	10
Decomposed basalt with bands of cemented sand	38	48
Quartz boulders in hard cemented sand	12	60
Decomposed basalt with gravel and cemented sand	23	83
Slate	2	85

Bore No. 19.

Black clay	4	4
Red clay	8	12
Red gravel	7	19
Decomposed basalt with bands of cemented sand	13	32
Drifty gravel	16	48
Basalt and quartz gravel	5	53
Stiff clay with small stones	13	66
Cemented sand	12	78
Fireclay	18	96
Alternate bands of cemented sand and gravel	25	121
Fire clay	23	144
Alternate bands of cemented sand and gravel	21	165
Cemented sand (struck water)	8	173
Tough clay	4	177
Cemented quartz gravelly "headings"	16	193
Quartz "wash"	2	195
Slate	1	196

GENERAL CONCLUSIONS.

From the presence of the fossil fern *Glossopteris* at The Springs, Black Ridge, and Hurley's Diggings, and the presence of the coal bands and associated shales at these and other localities, it may be concluded that in Permo-Carboniferous (Palæozoic) times a number of gold-bearing drifts have been formed, of which Cement Hill, Hurley's Cement Lead, Leo's Flat, the lower end of the Wild Cat Lead, and the deeper portions of Flyspeck are representatives. At Hurley's Cement Lead the presence of sandstone resembling that of the Drummond or "Star" Beds of the Devonian Age, in boulders of such large size there that they have not travelled any great distance, and also indicate the probability of the Drummond Bed once existing over this part of the country above the slates.

Another series have been formed probably in the Cretaceous, as there is the evidence of the quartzite rock "billy" covering drifts more recent than the Palæozoic. Such deposits occur at the Black Ridge and at the Miclere.

A third series of drifts have formed prior to or contemporaneously with basalt flows belonging to the Miocene Period, with which the Wild Cat Lead (in part), Dead Horse Lead, Blister Hill, White Hill Leads, and Deep Creek Lead may be grouped.

Then there is a great number of leads below the surface later than the flows of basalt, of Post-Pliocene or Pleistocene Age, instances of which are the upper iron-stained wash at The Springs, the "Basalt Wash" which cuts across the Dead Horse Lead, the Clermont Surface Lead, and the upper drifts at the Flyspeck.

Lastly, there are the Recent Deposits formed in the present watercourses.

Tabulating these results we have the following :—

Recent	Sandy Creek alluvium, &c.
Post-Pliocene	Flyspeck, Basalt Wash, &c.
Miocene	Dead Horse Lead, &c.
Cretaceous (?)	Black Ridge, Miclere (in part), &c.
Permo-Carboniferous (Palæozoic)	Black Ridge, Wild Cat (in part), &c.

The origin of the gold in the leads has been a question considered by many, and it certainly is not an easy matter to solve now, even with the additional evidence collected.

Dr. Jack in his Report* states that—

"It is evident that we are here dealing with two alluvial drifts of distinct age; one contemporaneous with or prior to, say, Permo-Carboniferous, and the other of later date. Both have been derived from the same source—viz., metamorphic rocks older at least than the newer members of the Permo-Carboniferous series, and according to my view the base of the one is as likely as the base of the other to contain gold and other detritus from the denudation of auriferous reefs or leaders."

And further on (*l.c.*: page 14) he continues—

"My general impression is that in addition to a few known reefs, whose records are as described by Mr. Rands, the whole country in the neighbourhood of Clermont and Copperfield is full of quartz veins, perhaps of the type referred to under the head of the Venus. Some such veins have occasionally been dropped across in surfacing operations, and have proved very rich. Possibly it is from an immense number of such veins rather than from distinct reefs that the bulk of the alluvial gold may have been derived."

The evidence recently accumulated shows that from the occurrence of the fern *Glossopteris* in the fine layers of shale and coal interbedded with the "tish" carying gold, the "tish" deposits are portions of the Permo-Carboniferous Coal Measures. Further, these old alluvial deposits at comparatively shallow depths have been subjected to the same agencies of denudation as the gold-bearing metamorphic rocks close to them, and therefore would part with the alluvial gold they contain, as the older rocks would their reef gold, to form the more recent deposits. The gold in the later formed leads obtained from the older leads would be further concentrated by the operation, so that the newer leads, generally, should be richer than those belonging to the Permo-Carboniferous.

The wet ground at the eastern end of the Wild Cat Lead is probably of Permo-Carboniferous Age, and, if the above theory be correct, we should expect the lead in that direction to be poor. On the other hand, some of the leaders exposed on the surface of the slates and other metamorphic rocks have been exceedingly rich in patches, and, of course, the recently formed surface leads close to them may be very rich without any concentration at all.

Around Clermont there are many localities which the prospector has not touched, and from the information obtained all over the district many of the leads are not yet exhausted, and others are bound to be found. At the same time a repetition of the rich yields of the past cannot be expected again.

The country which impressed the writer as being favourable for gold is that around Western Creek, but very little development has taken place in that direction, as it is badly situated for water. Hurley's Cement Lead and the basalt-covered country at the northern end of the Victoria Lead at The Springs have many favourable features, and must ultimately attract attention.

A perusal of Map 2 will show the bores put down by the Clermont Prospecting Association, and, now their proper position has been fixed and mapped, an opinion can be expressed on the merits of the work. The lower workings of the Wild Cat Lead showed that the wash was not rich, and that the lead here has spread out considerably wider than any other part of it. Under normal conditions, the further east the lead trends the poorer it would become, and this is where the line of bores would cross.

On the southern end of the line of bores at Deep Creek Lead several shafts were sunk without finding any defined lead, and at the end of the lead the wash was poor. We have, in short, the lower ends of two leads exhausted of gold connected with a line of bores.

West of the line of bores the country is covered by black soil, below which there must be a continuation of the slate country on its northern, southern, and western sides. If the basalt from which the black soil has been derived, and which covers the slate, has also covered leads between the Wild Cat Lead and the Deep Creek Lead, it can hardly be expected that they would reach as far east as the line of bores without the wash they might contain being considerably reduced in richness. Possibly the colours obtained in some of the bores have been in the tail-end of some such lead, of which the main portion might be a mile further west.

Considering the matter from another point of view, it would be remarkable, indeed, if no leads occurred within this blacksoil area with such a number of leads all around it, and which, had they been covered by black soil and no surface indication of their existence, would very probably have remained untouched up to the present day.

In tracing the leads, no difficulty was experienced with those of recent formation, but with those earlier than Post-Pliocene, the tracing of them became impossible, not so much from their being partly covered by more recent deposits, but because so much of the material composing them has been removed by recent denudation. The only resource for the miner will be, then, to rely on picking them up by prospecting in a systematic manner.

It was thought the relation of the leads to one another might be determined by making bullion assays of the gold from all of the leads, and then connecting those whose gold was much alike in quality, but there were so many leads deserted, and the amount of gold obtained from others so small, that the attempt to connect one with the other by the quality of their gold had to be abandoned.

Concerning the reefs of the district, it must be admitted that they have been of secondary importance up to the present time, when compared to the great number of leads which have been worked. The yields of the reefs also have been very insignificant when compared to those from the leads, a comparison of which can be made on referring to the table showing the "Clermont Gold Field Returns" for a great number of years, at the end of this Report.

Although the reefs up to the present have not yielded very much gold, there is every reason to suppose that the reefs will be yielding gold when all the alluvial deposits are worked out. There are, as shown in the preceding pages, several reefs in the district which are well worth attention being directed to them, of which the Star of Hope line of reef and Bedford's Reef may be specially mentioned.

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* Ann. Prog. Rep. of the Geo. Survey. 1894, p. 12.

APPENDIX

Clermont Gold Field Returns.

Year.	Tons Crushed.	Average per Ton.	Reef Gold.	Alluvial Gold.	Total.	Value.
		Oz. dwt. grs.	Oz.	Oz.	Oz.	£
1878	...	...	1,842	2,158	4,000	15,000*
1879	968	...	519	5,481	6,000	22,500*
1880	2,293	...	1,088	6,312	7,400	27,750*
1881	2,547	0 5 2	757	6,718	7,475	28,031*
1882	1,211	0 13 17	842½	5,157½	6,000	25,500*
1883	484	0 10 1	243	2,757	3,000	11,250*
1884	652	0 8 0	275	2,993	3,268	12,300*
1885	213	0 11 4	118½	3,545½	3,664	13,740*
1886	746	0 6 9	253	4,104	4,357	16,338*
1887	486	0 12 19	310	4,108	4,418	16,567*
1888	124	0 11 0	68	2,277	2,345	8,793*
1889	71	1 19 3	139	1,947	2,086	7,818*
1890	...	...	...	1,939	1,939	7,272*
1891	...	...	...	3,549	3,549	13,309*
1892	...	...	...	3,622	3,622	12,138*
1893	...	...	...	5,963	5,963	22,362*
1894	...	...	...	7,308	7,308	27,405*
1895	...	...	...	11,986	11,986	40,752
1896	...	...	...	12,683	12,683	50,732
1897	2,500	0 4 12	560	22,006	22,566	88,864†
1898	2,549	0 5 5	664	30,811	31,575	123,209
1899	774	0 16 7	630	11,305	11,935	47,740
1900	741	0 15 5	563	7,671	8,234	32,742
1901	1,138	0 17 8	1,034	8,992	10,026	39,449
Totals for 24 years	17,497	0 12 12	9,906	175,493	185,399	£711,561

* Officially estimated at £3 15s. per ounce.

† Year that Dead Horse Lead was discovered.

Brisbane, 30th March, 1902.

B. DUNSTAN.

Price 4s. 3d.]

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane.

GEOLOGICAL SKETCH MAP

of portion of the

CLERMONT DISTRICT

shewing

Position of Auriferous Leads and Reefs

accompanying Report on the Clermont Goldfield by

B. DUNSTAN F.G.S.

Assistant Government Geologist

1902

Scale 119 Chains to an Inch

0 119 238 357 476 Chains.

0 1 2 3 4 5 6 Miles.

Slates and Schists containing abundance of small Quartz Reefs & Ironstone "Blows" more or less auriferous sometimes capped with a more recent Sandstone

Western Reefs

Western Creek

Scotchman Lead

Brigalow Creek

Decima Lead

Specimen Lead

DRUMMOND RANGE

ITALIAN REEF

Seven Mile Diggings

Two Mile Diggings

Cockatoo Dam

Green's Gully

Hurley's Diggings

Hurley's Dam

Hurley's Creek

Hurley's Deep Lead

Hurley's Central Lead

Rip & Tare Lead

Blacksmith's Gully Lead

Hurley's Wet Lead

Venus Reef

Venus Lead

Venus Hotel

Four Mile Diggings

Gregory Ck

Sandy Ck

Bottle Tree Creek

Oaky Creek

Slates and Schists and other Metamorphic Rocks

Q

Quartz on Ridges

W.H.

B

TRACK FROM MOLARE

Johnstone's Camp

17 Mile Well

Mc Master's Camp

Yankee Camp Flat

Range very low

WHITE'S HILL

Old Yankee Camp

P.P. 79

BATHAMPTON

Basalt covering Coal Measures

Yankee Creek

Blair Athol Coal P.C.

School

Native Bee Diggings

Bathampton or Fiddler's Creek

Fiddler's Creek Lead

Patrick's Lead

Taylor's Ck

TAYLORS HILL

True Blue Lead

Chinaman's Gully Lead

Leo's Flat

Bore

Leo's Flat

Surface Workings

Two Mile Ck

Surfacing

Black Snake Lead

Sandy Creek

The banks of Sandy Creek contain

Auriferous Gravels on Slate ridges & in water Courses

Apsley Creek

Gravel below Basalt

Range very low

Massive beds of "Billy"

Black Ridge Leads below Basalt

The Springs Leads

SPRING RUSH GOLDFIELD

Gowrie Creek

Tinaroo Creek

Basalt & Black soil

PROSPECT HILL

Basalt covering Slates

Low Basalt ridge

Greenlea Ck

Wolfang

MT MILSOM

Slates

Basalt covering Coal Measures

Apsley

Apsley 5

Crispin Plain

Basalt covering Slates and Schists

Coal Measures

Waring Creek

QUARRY HILL

CLERMONT

RAILWAY

Police Paddock

Dead Horse Lead

Wild Cat Lead

Series of boreholes along here

Basalt covering drift

Deep Ck

Numerous Leads here

Several reefs on ridge here

McDonald's Flat

Bedford's Leases & Reefs

Area enlarged on Map 2

Star of Hope & other Reefs

N. COPPERFIELD

Mining Leases

Copper

Peak Downs

S. COPPERFIELD

Drummond Creek

ROAD FROM ARAMAC

DRUMMOND

P.C. Permo-Carboniferous

B Basalt

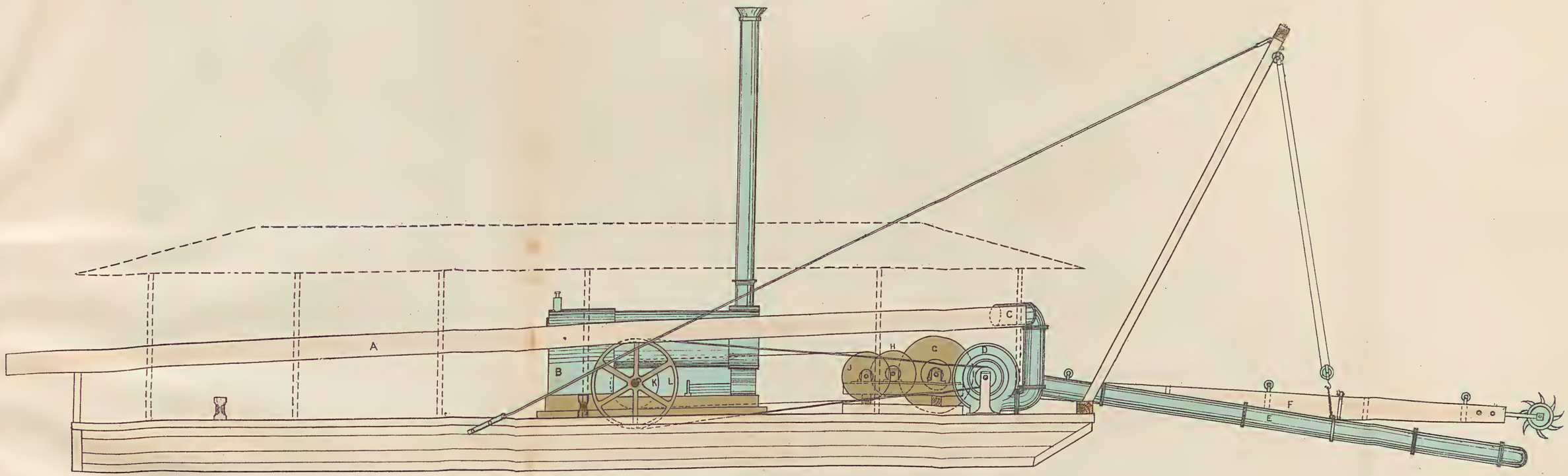
Q Age undetermined

"Billy"

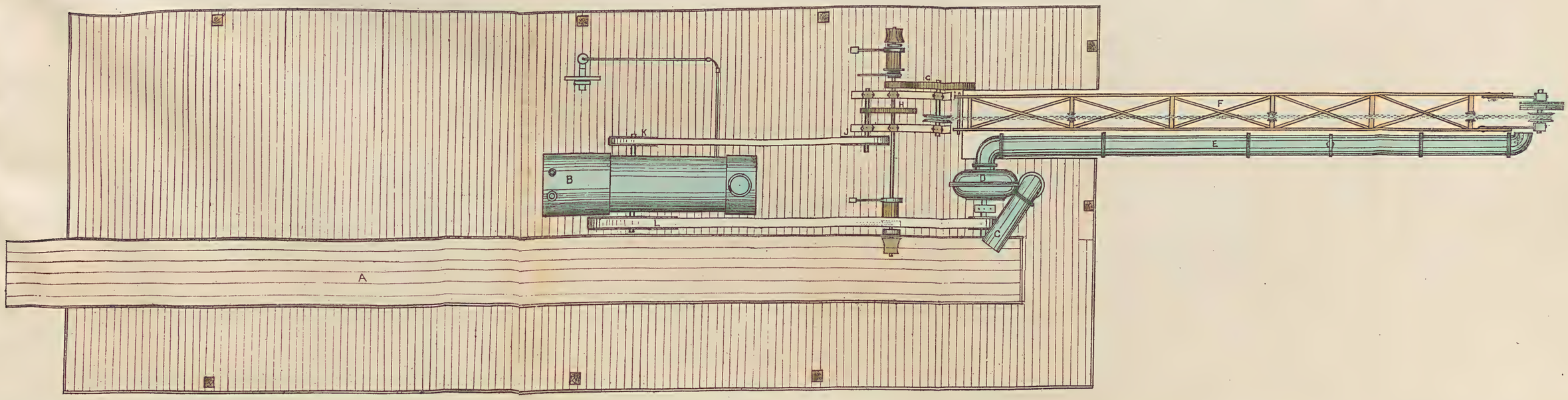
VICTORIA

CLERMONT GOLD-DREDGING PLANT

SCALE 0 6 12 OF FEET



SIDE ELEVATION



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NATIONAL VICTORIA

Contour Map
of portion of the
CLERMONT GOLDFIELD
accompanying Report by
B. DUNSTAN F.C.S.
Assistant Government Geologist
1902

Scale
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0 ¼ ½ ¾ 1 Mile.

REFERENCE
100 Altitudes (Aneroid)
Contours
Alluvial deposits
Reefs

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